SEPTEMBER 7, 1959

American Machinist

THE MAGAZINE OF METALWORKING MANUFACTURING

A McGraw-Hill Publication • Seventy-Five Cents

Can silica-reinforced plastics replace metals at high temperature?—see page 110

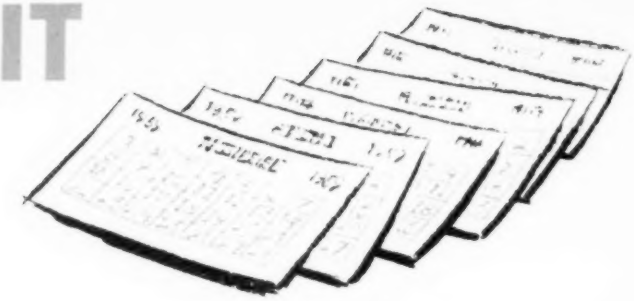
Guide to Blind Riveting—Special Report, page 137

Right heat treatment keeps it stainless, page 132

WHY WAIT

longer

for a new machine?



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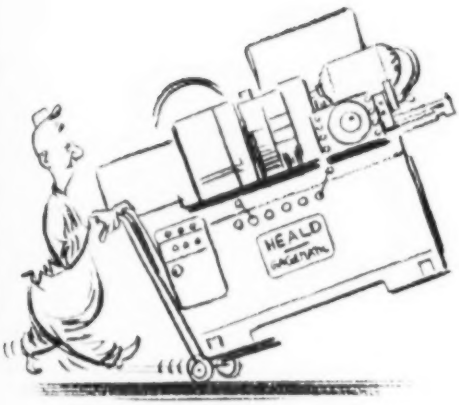

As a result of Heald's recently instituted stock machine program, the most popular types and sizes of Heald precision finishing machines are normally carried in factory stock at Worcester. Any time you can buy a *stock machine*, and supply your own fixtures and tooling, you get these important advantages . . .

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3. UNLIMITED VERSATILITY. Every Heald stock machine has the inherent versatility of speeds, feeds and cycling that permits easy adaptability to virtually any combination or sequence of operations.

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THESE STANDARD HEALD MACHINES ARE NORMALLY CARRIED IN STOCK

BORE-MATICS

Model "0" Model 421
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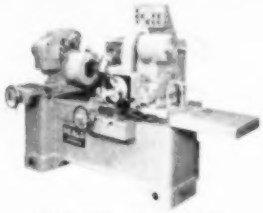
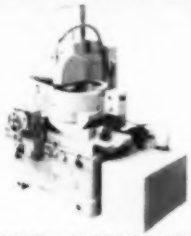
Model 221 Model 322
Model 321 Model 422



INTERNAL GRINDERS

Model 171 Size-Matic
Model 171 Gage-Matic
Model 271 Plain
Model 271 Size-Matic
Model 271 Gage-Matic
Model 271 Tool Room
Model 272 Basic
Model 273A Universal



ROTARY SURFACE GRINDERS

Model 181 6"
Model 281 16" Plain
Model 261 16" Automatic
Model 361 24" Plain
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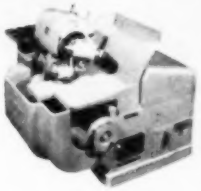

TOOL SHARPENING MACHINES

Model 3
Model 4

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COVER:

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American Machinist

THE MAGAZINE OF METALWORKING MANUFACTURING

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TURN PAGE FOR METALWORKING REPORT ⟶

METALWORKING REPORT

Significant current developments in tooling and production processes

CUTTING

Cuts Spheres Faster

Forged ball studs are machined in two operations that take only 39 seconds at a pair of machines designed for an auto company by Micromatic Hone. Rough machining is done with a special tool that removes 0.068 in. of stock from the sphere. The trick is how the first machine maintains constant surface speed on the work all the way around the spherical surface of the ball. This machine bypasses the usual problem when the cutting tool cuts to the machine centerline—and, in effect, cuts at no surface speed at center.

Second operation is to microhone the work to 0.0003 in. and surface finish of 6-10 mu in. Roughing takes 15 seconds; finishing 24 seconds, floor-to-floor time.

Improved cutting action produces accuracy to 0.0005 in. in the first operation, and results in a "rough" surface of 40-60 mu in. Part of the technique involves mounting the work so the ball crest (at centerline) and skirt are on a line parallel to the spindle axis.

Simplified Bearing Sizing

Angular-contact ball bearings are preloaded with precision at Norma-Hoffman's new plant by a special grinding cycle that includes in-cycle air gaging. One part of the process is to grind bearing races on rotary tables to close dimensions, then selectively assemble them to matching races. One race must stick out a prerequired amount beyond the edge of the other race so specified preloading, when the bearing is assembled, will line the races up exactly. This permits universal application of the bearings in duplex arrangements.

Rotary grinders are equipped with in-cycle air gages that measure the height of each race above the grinder table. This measurement reads out to a large dial at the machine. The gage is interlocked with the machine vertical feed so the race cannot be ground down too far.

FORMING

Cast-Iron Inserts

A relatively simple method of bonding cast-iron inserts into aluminum die castings—cylinder sleeves into engine blocks, for example—is the subject of a patent application.

A F Bauer and J S Mikus of the Doehler-Jarvis Div, National Lead Co, developed the "B M I" bond (Bi-Metallic Interlock). Besides engine applications, use for cast-iron liners in brake drums is foreseen. The bond was developed to eliminate machining, as is normally required for an insert, and is said to eliminate voids.

Roughness of the as-cast surface of a cylinder sleeve is an advantage, not a disadvantage as ordinarily supposed. The casting is cleaned by sand blasting or immersion in a salt bath to remove the mold coating. The cleaning uncovers an irregular surface, which is formed by a mass of small undercut protrusions and crevices.

In the die-casting process, the cast metal is forced into the passages of the undercut surface to produce interlocking of the two metals. The bond obtained is strong and ductile. Mechanical properties of the B M I bond are reported superior to those of a metallurgical bond. Intimate contact is maintained even at elevated temperatures, and hence the heat transfer properties are improved. Shear strength of bond, 18,500 psi; tensile, 6400 psi.

Thin-Wall Swaging

A cold-draw-forming technique for swaging high-strength heat-resistant alloy tubing has been developed by manufacturing research engineers of the Boeing Airplane Co, as the answer to the problem of reducing one end of a 2-in. dia by 0.01-in. wall M-252 tube down to ½-in. diameter.

A design application for anticipated hypersonic vehicles called for 2-in. tubing for structural use which would provide maximum support with minimum weight. The structural members had to be joined.

Ordinary joining methods—welding, clamping, riveting, sleeving—were discarded because they would collapse the thin-wall tubing. To permit any type of joining, the wall thickness had to be increased at least 300% without increasing the over-all weight. The size of the tube had to be reduced to permit several structural elements to be joined in several different planes at a single point. Both goals could be accomplished by decreasing the diameter of the tube at the joint.

The Boeing process utilizes nested aluminum tubing to prevent collapse of the super alloy during swaging. The aluminum tubing then is discarded. Through an eight-stage reduction with interstage anneals, the end of the tube was reduced and smoothly tapered on a 10° angle to ½ in. dia. Reducing the size of the tube increased the thickness of the metal to 0.033 in., making the tubing acceptable for conventional joining techniques.

The work was done on a standard Vail No. 7 tube-end former with conventional drawing dies of Amco bronze.

An alternate process, which employs a button die, was developed by Boeing researchers for seamless tubing. This process entails rotation of a three-fluted die at approximately 300 rpm, with the tube being fed into the flutes. The action of the flutes causes reduction.

HEAT TREATING

Carburizing Furnace

A 57-ft-long, continuous pusher-type gas-carburizing furnace automatically treats up to 700 lb per hr of ring gears, spider gears, ball studs, and other truck parts at The White

Motor Co's manufacturing plant in Cleveland. Built by Surface Combustion Corp, the furnace provides exact control of dewpoint and temperature through five different zones, resulting in highly uniform case depth and hardness.

Temperatures range from 1700 to 1550 F and dewpoint from −5 to +25 F in the five zones. Furnace is reported to be the first to use an externally movable slot door for manual extraction of individual gears for press quenching.

INSPECTION

Precision Laboratories

Precision calibration laboratories will be in operation at most large Air Force bases by the end of 1959.

Under a $6 million contract, 163 bases will be equipped. Average bases will have 10 technicians and 2000 pieces of equipment.

Under Air Force Regulation—74—2, revised May 12, 1959, a single integrated system was set up for repair and calibration of all precision measuring equipment used in the Air Force, mainly in maintenance in the field and at depots.

Calibration laboratories at Air Materiel Areas have been enlarged to meet the needs of the base program. Each AMA laboratory has 35 to 40 persons and $750,000 in equipment.

Contractors are involved in the program. The Air Force is taking action to insure that contractors have calibration systems of their own to provide built-in-accuracy of weapons.

Certified to 0.0000002 in.

For the first time in its history, the National Bureau of Standards has certified the calibration of two gage blocks, or length measures, to an accuracy of better than one part in five million (0.0000002 in.). The blocks, submitted for calibration by Moore Special Tool Co, are 16 and 18 in. long. As a test device, two techniques were used and the results agreed very closely. In one technique conventional line standards were used and in the other method measurement was in terms of wavelengths of light. Results agreed to the nearest millionth for one block and they differed by only one millionth of an inch for the other block. Present normal calibration at the Bureau is one to two parts per million. The special work was done under a program jointly sponsored by the NBS and industrial firms to achieve an accuracy in gage-block calibrations of 0.0000001 in.

THE OUTLOOK

Strike-caused steel shortages are still acting as a restraining influence on the fast upward climb of metalworking production, but by the third quarter output should again be well on its way to new highs (see p101).

ASSEMBLY

Automatic Transistor Assembly

Western Electric has announced success with a completely automatic transistor-assembly machine at its Allentown, Penna, plant. The equipment consists of coordinated assembly devices that each does a single assembly operation—such as join header units. The most critical single operation is a test station where the photoelectric properties of each NPN bar, assembled to a pair of thin Kovar ribbons is tested against a standard transistor. If the assembly attains a set standard, a signal operates the welding mechanism that joins this subassembly to the header. If the subassembly does not check out, welding does not occur and the parts are later ejected. The machine was developed to assemble grown-junction transistors, which may soon become obsolete, but the ideas should apply to more modern transistors to reduce prices on high-quantity types.

FINISHING

Portable Sandblaster

According to Polish sources, a portable sandblasting unit has been developed at the Gdansk shipyard. Easily handled by one man, the unit weighs only 15 lb, measures 25 by 16 by 20 in., and operates on a closed, vacuum cycle that virtually eliminates escape of blasting dust into the atmosphere. Air at 70 psi serves to project the abrasive and, by verturi action, to create a vacuum to pick up spent abrasive and return it to the hopper.

Air consumption is about 106 cu ft per hr at 70 psi, and abrasive consumption is approximately half a pound per sq yard of surface cleaned. Time and cost checks against pneumatic scraping, shot blasting, and gas burner and wire brush showed the new unit to be considerably the cheaper and faster.

Volatile Corrosion Inhibitors

When using VCI-on-Kraft paper for protecting steel parts against corrosion, don't mix different types of paper in the same package. Research at Rock Island Arsenal has shown that if different papers are combined under pressure in packaging there is incompatability between them, and that incompatability increases under conditions of high humidity. On the other hand, the various vapors are completely compatible, so there is no danger in mixing these. Binders, such as casein, used in the papers contribute to staining the steel parts.

Polish by Melting?

High-current, low-voltage electric heating can be applied to polish flat steel parts economically, according to a report by the Orasul Stalin tractor works in a Rumanian technical weekly. Low voltage is attained with a stepdown from 360 to 16 v, current is 2000 a. The workpiece is pressed pneumatically against a cast-iron disk, which closes the electric circuit and produces current flow between the work and the disk. This results in local melting, which polishes the work. The system is claimed to increase productivity 600-800% and reduce processing time about 50%. This eliminates polishing dust. Power is fed by a graphite-coated copper brush.

MATERIALS & COMPONENTS

Heat-Resistant Masking Tape

Crepe-paper masking tape that will withstand the heat of metal spraying and resist the abrasion of shot or grit blasting has been developed by John Gosheron & Co Ltd, London, England. Called Hytem 577, the tape can be applied to any metal surface to mask off those areas that are not to receive treatment.

In a typical application, crankshaft cheeks are protected by the paper while the crankpins are built up by blasting with aluminum-oxide grit, then sprayed with molybdenum at 5000 F to form a bonding coat, followed by spraying with high-carbon stainless for several minutes. The paper can then be stripped away without leaving any adhesive on the metal.

METALWORKING REPORT . . .

High Production—Small Lots

Westinghouse's Small Motor Div, Lima, Ohio, keeps up fast machining and work handling rates on low production quantities because parts being made are standardized in design, and many similar parts can be machined at the same setups even though some dimensions vary. For example, copper resistance rings are slotted for special squirrel-cage motors of various sizes; all rings are done at the same setup, which has an adjustable stroke for the work head. Rings can be of any thicknesses; all are machined equally well at the same machine. See p 130.

MATERIALS HANDLING

Fluid Drive for Handlers

A new fluid-drive system that eliminates the conventional clutch and transmission, replacing them with a single control lever, has been developed for such materials handlers as tractors, fork trucks, and cranes. The system, developed by Dowty Hydraulic Units, Ltd, a British firm, consists of a variable-output oil pump through which the vehicle's engine provides a high-pressure but low-velocity flow of oil to a hydraulic motor linked to the driving wheels. Based upon long-known principles, system has only recently been perfected enough to allow combining sufficient power with acceptable weight and size for use in vehicles.

Once the engine is started, the driver has only to move the control lever forward or backward to obtain the full range of movement from full ahead to full astern. At the neutral, halfway position, the engine turns over freely but the wheels remain locked. There is no need for brakes, except one for parking.

Because the system eliminates many parts, including the mechanical drive line, users can gain great flexibility in vehicle design, according to the developer. Maneuverability in rough terrain is claimed to be much greater.

MANUFACTURING CONTROL

TQC and Productivity

What's the soundest way to improve productivity? According to H B Miller, Vice President of Manufacturing Services at General Electric Co, it's *not* increased product volume or new-product exploitation. Key to better productivity, Mr Miller recently told an ASME conference in Detroit, is quality control of present productivity and products.

As part of its "Total Quality Control" concept, GE made a study to determine what areas its quality-control expenditures included. Study showed that out of every TQC dollar, 62¢ went into failure costs, 28¢ into appraisal costs, and 10¢ into prevention costs. Of the latter cost, 6¢ was spent on maintenance of patterns and tools, only 4¢ on pure prevention.

The survey caused GE management to launch a program of more expenditures on pure prevention, with the idea that reductions in failure and appraisal costs would be much greater than the cost of additional prevention. This "make it right the first time" program was highly successful, decreasing the cost of quality control and at the same time increasing productivity.

Data-Processed Autos

Two European automobile plants have recently installed data-processing equipment that helps them to smooth integration of customers' orders and their own production facilities.

At the Poissy, France plant of Simca, an electronic brain programs operations on a wide range of models (35 variations in the Aronde series alone) and a great variety of color-trim combinations. For the paint line, for example, the brain acts as a super-human traffic cop, directing the flow of bodies along five miles of conveyors. The brain gets each body into the proper paint tunnel, then triggers one group—that with the proper color—of a battery of automatic spray guns.

The Ruesselsheim, Germany plant of Opel transfers data on all car orders to punched cars. Data includes vehicle type, color, upholstery type and color, type of accessories (standard or special), and type of model (domestic or export). Details on the punched cards are transmitted by teletyper, at the correct time, to the various departments involved: the departments then can process the data and deliver parts.

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American Machinist is indexed regularly in the Engineering Index and the Industrial Arts Index. American Machinist publishes its own annual index; this is available on request to the editor.

A McGRAW-HILL PUBLICATION

American Machinist, published bi-weekly, with an additional issue in mid-September, by McGraw-Hill Publishing Company, Inc. James H. McGraw (1860-1948), Founder.

EXECUTIVE, EDITORIAL, CIRCULATION, ADVERTISING and PUBLISHING OFFICES: McGraw-Hill Building, 330 West 42nd St, New York 36, NY. Donald C. McGraw, President; Joseph A. Gerardi, Executive Vice President; L. Keith Goodrich, Vice President and Treasurer; John J. Cooke, Secretary. Officers of the Publications Division: Nelson Bond, President; Harry L. Waddell, Senior Vice President; Ralph B. Smith, Vice President and Editorial Director; Joseph B. Allen, Vice President and Director of Advertising Sales; A. R. Venezian, Vice President and Circulation Coordinator.

Subscriptions are solicited only from production executives and engineers in the metalworking industries. Position and company connection must be indicated on subscription orders.

United States subscription rate for individuals in the field of the publication $5.00 per year, single copies 75 cents. Canada $7.00 per year, foreign $25.00 per year, payable in advance. Second-class postage paid at New York, NY. Printed in USA. Title registered in U S Patent Office.

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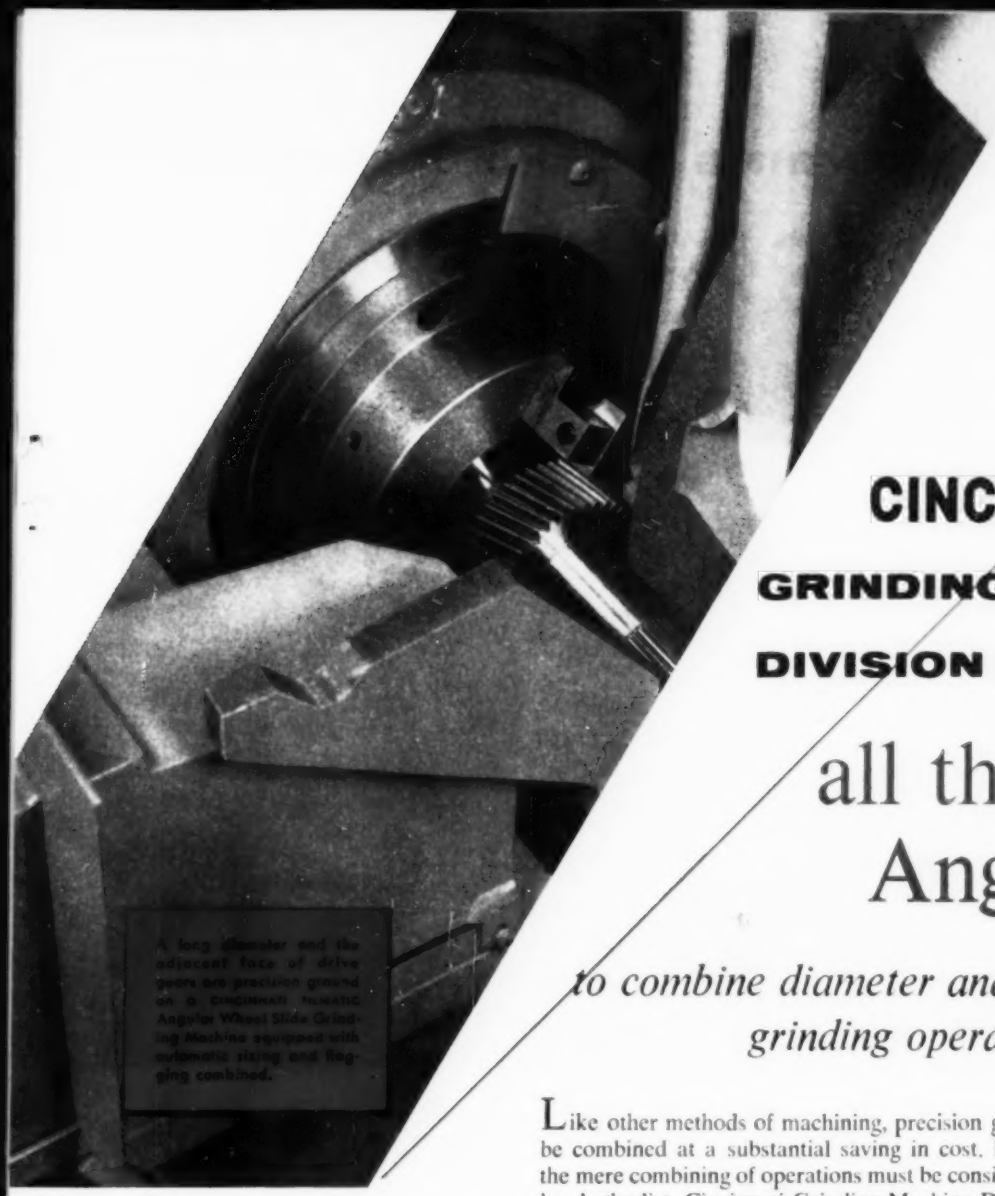


A lacy diameter and the adjacent face of drive gears are precision ground on a CINCINNATI HYDRAFEED Angular Wheel Slide Grinding Machine equipped with automatic sizing and flagging combined.

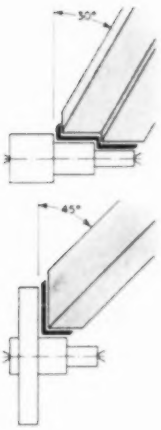
CINCINNATI GRINDING MACHINE DIVISION checks all the Angles . . .

to combine diameter and shoulder grinding operations profitably

Like other methods of machining, precision grinding operations often can be combined at a substantial saving in cost. However, factors other than the mere combining of operations must be considered. Accurate wheel truing heads the list. Cincinnati Grinding Machine Division Specialists solved the problem in a unique and highly successful manner for angular wheel slide grinding.

The wheel is *automatically* trued to exact profile by merely pushing a button at front of the machine. A balanced hydraulic system, incorporating longitudinal and transverse cylinders under control of a directional integrating valve, assures sensitive, precise duplication of the cam contour in the wheel. Profile slide way is anti-friction; no twist, no stick-slip.

Combined diameter and shoulder grinding operations are analyzed from every angle by Cincinnati Grinding Specialists. These men have two wheelhead arrangements on which to base their recommendations—30° for diameters having a length considerably greater than the height of the shoulder, and 45° where height of shoulder equals or exceeds length of ground diameter. Other feature-advantages and interesting applications are shown on the two pages following. Complete details in catalog No. G-686-1. **Grinding Machine Division, The Cincinnati Milling Machine Co., Cincinnati 9, Ohio.**



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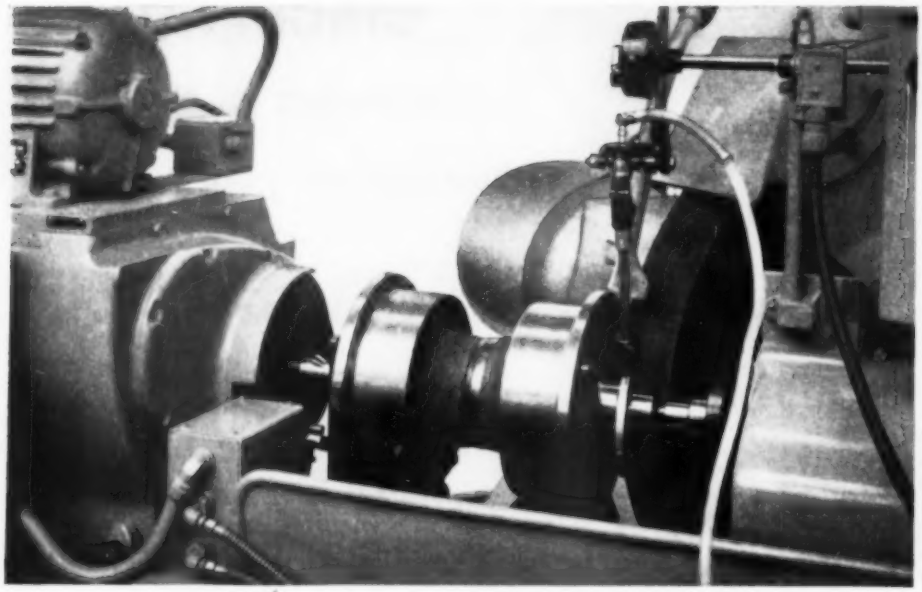
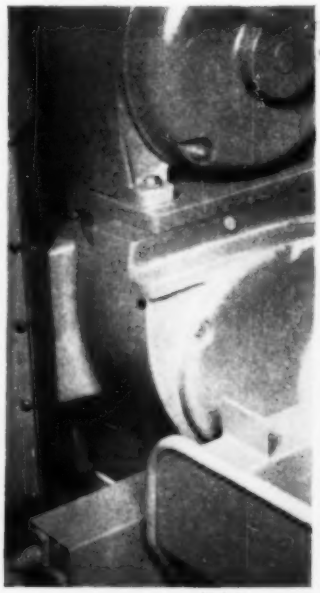
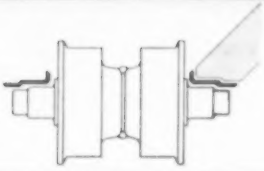
Incorporates Dependable

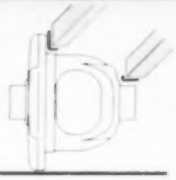
in Angular Wheel Slide



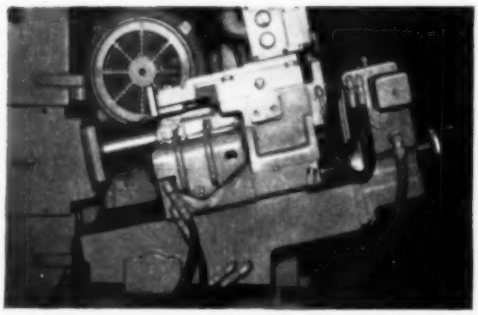




TWO DIAMETERS AND ADJOINING SHOULDERS on each end of track rollers are precision ground on a CINCINNATI FILMATIC 14"L x 36" Angular Wheel Slide Grinding Machine, equipped with automatic count truing and automatic air-electric gage sizing.



WHEEL TRUING UNIT, push-button operated from front of machine. Balanced hydraulic system and two-way truing assure precise duplication of cam contour in face of wheel.



BUILDERS OF PRECISION GRINDING MACHINES: CENTERTYPE • CENTERLESS • MICRO-CENTRIC

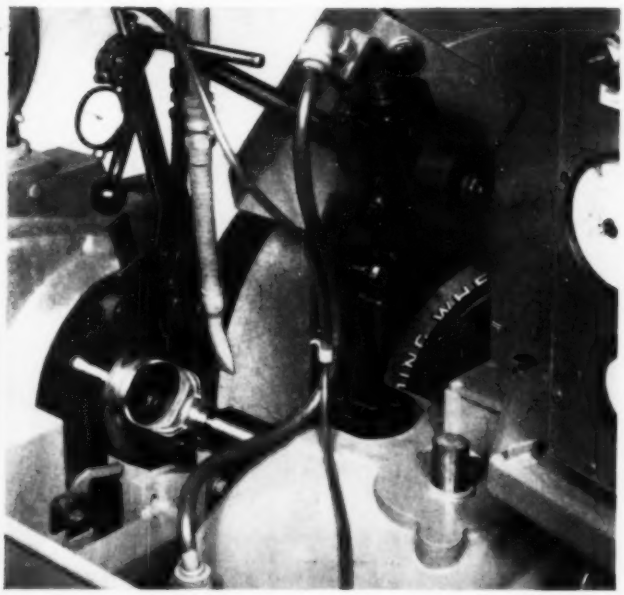
THE CINCINNATI MILLING MACHINE CO., CINCINNATI 9, OHIO

CIRCLE 155 READER SERVICE CARD

CINCINNATI FILMATIC

Productivity

Grinding Machines

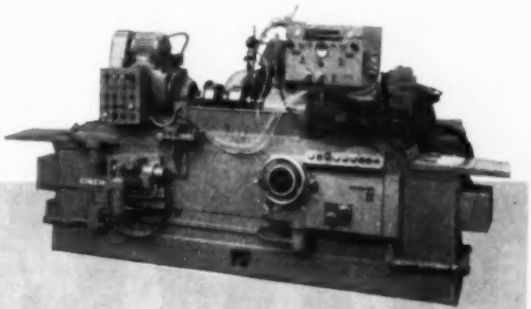


TWO DIAMETERS DIFFERING GREATLY IN SIZE and adjacent faces are automatically ground at the rate of 61 per hour on a CINCINNATI FILMATIC 10"R x 18" Angular Wheel Slide Grinding Machine.

POSSIBILITIES UNLIMITED might well be the introduction to CINCINNATI FILMATIC Angular Wheel Slide Grinding Machines. Two interesting applications are shown here. Both incorporate Cincinnati automatic features which augment the many cost reducing feature-advantages of these fine machines.

Wheel truing, perhaps the No. 1 consideration in combining precision cylindrical grinding operations, is an exclusive automatic cycle profile type, and can be manually started or automatically controlled through a counting device. The automatic infeed cycle incorporates rapid approach, coarse feed and fine feed rates for sizing and finish. For extra high production work where stock allowances are inconsistent, the Gap Eliminator can be included, to cut down the time spent in "grinding air." Automatic sizing and flagging are highly desirable quality control features.

The machine itself includes every element of Cincinnati quality construction and dependable productivity . . . FILMATIC grinding wheel spindle bearings . . . automatic grinding wheel balancing . . . automatic hydraulic table clamp and nine additional standard feature-advantages. Get complete information by writing for catalog No. G-686-1.

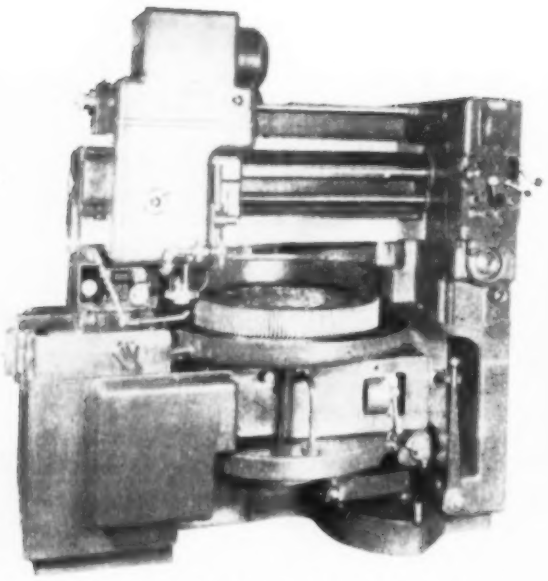


CINCINNATI FILMATIC 14"L x 36" Angular Wheel Slide Grinding Machine, equipped to grind track rollers illustrated at the left. These machines are also built in 6" and 10" swing sizes. Catalog No. G-686-1.

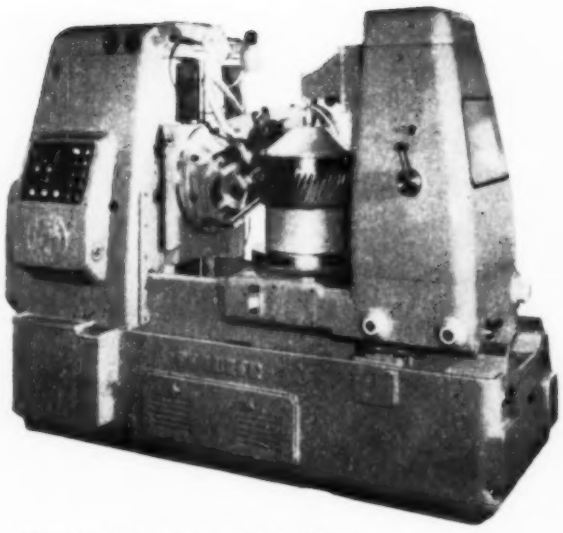
• ROLL • CHUCKING • CENTERLESS LAPPING

CINCINNATI®
GRINDING MACHINE DIVISION

CIRCLE 156 READER SERVICE CARD



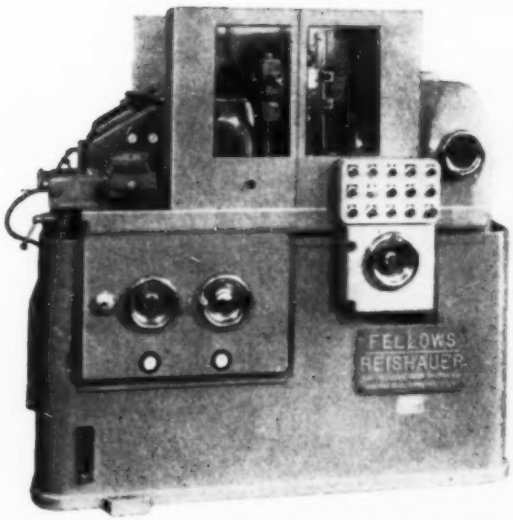
Fellows Gear Shapers cut internal and external spurs and helicals; capacities up to 120" P.D.



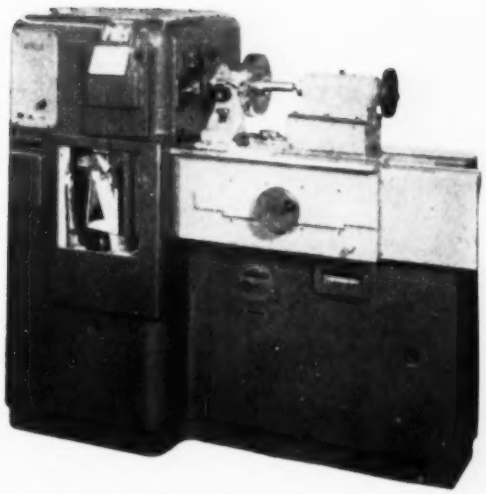
Pfauter Gear Hobbing Machines cut spur and helical gears; capacities up to 120" P.D.

COMPLETE COVERAGE

FOR EVERY REQUIREMENT IN MODERN GEAR SHAPING, HOBBING, GRINDING AND INSPECTION EQUIPMENT!



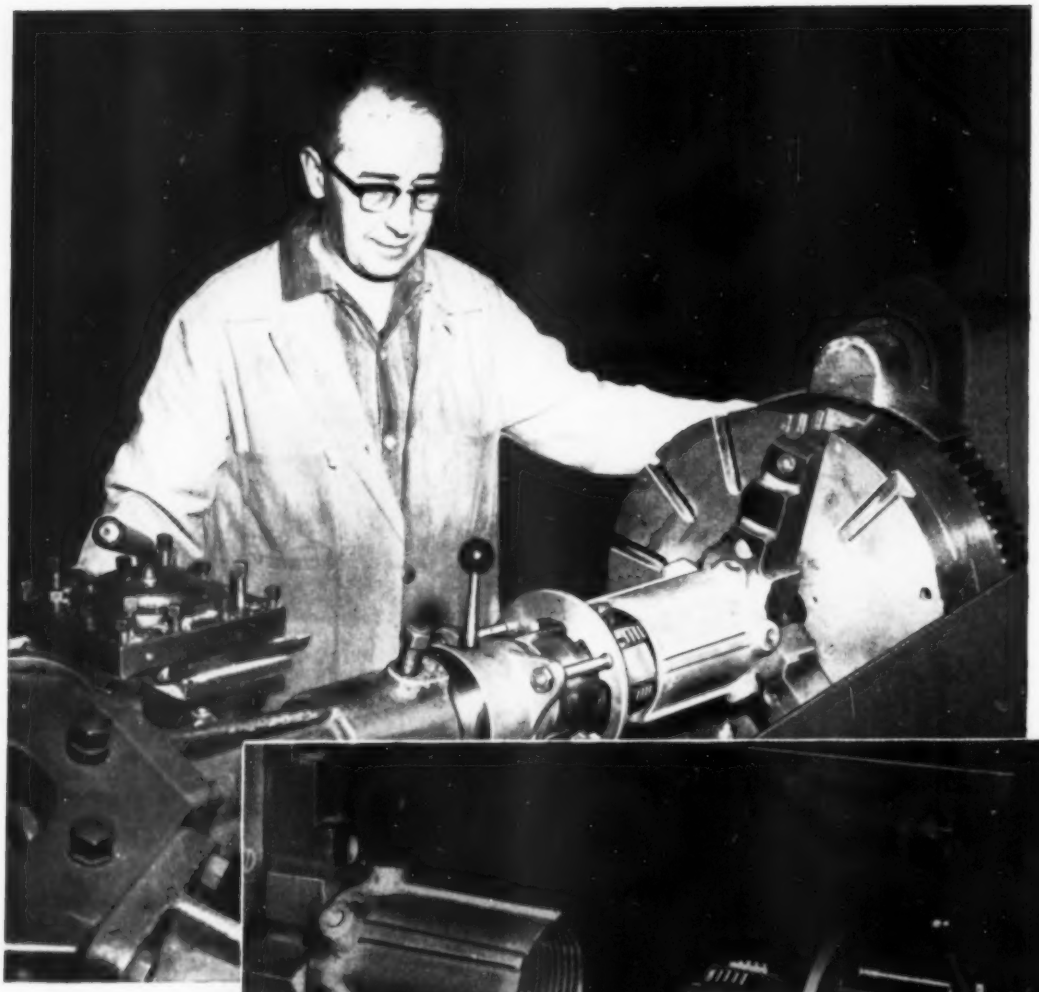
No. 12 Fellows-Reishauer Gear Grinding Machines grind spurs and helicals up to 12" O.D.

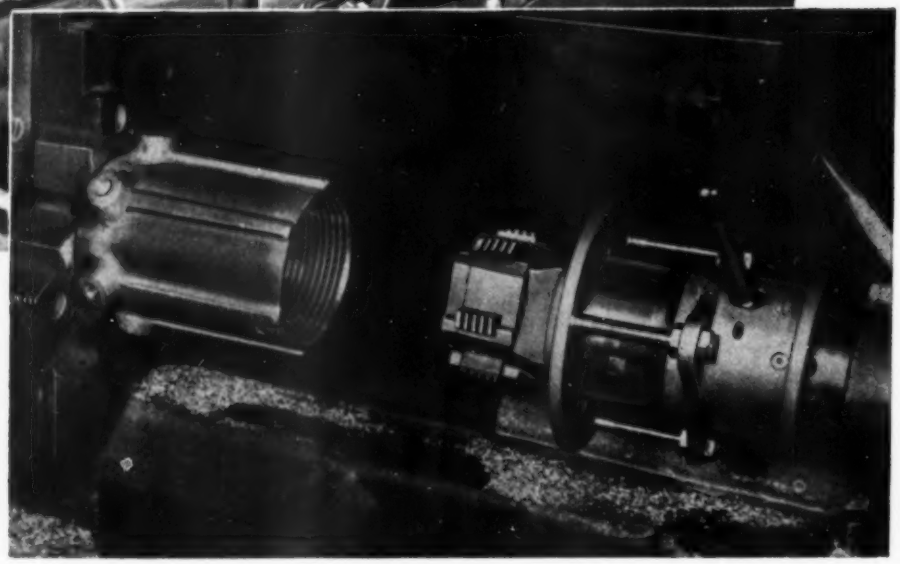


Fellows Inspection Instruments check gears for involute profile, lead, taper, crown and composite errors; capacities up to 24" P.D.

Now Fellows delivers everything except the operator! No other machine tool builder offers every type of gear production machine: Fellows Gear Shapers, Pfauter Gear Hobbers, Fellows-Reishauer Gear Grinding Machines and Fellows Inspection Instruments! And that's not all: if you have gear production problems that we haven't met in over sixty years of specialization, we'll take solid New England pride in meeting and solving them now. For example: our high-speed electronic computer can make short work of special gear and cutter design problems you have. Ask your Fellows Representative to show you how new machines from Fellows can help you keep up in the productivity race. He can give you complete information about Fellows' full range of gear production and inspection instruments for every modern need, or you can address any inquiries to: The Fellows Gear Shaper Company, 78 River Street, Springfield, Vermont. Branch Offices: 1048 North Woodward Avenue, Royal Oak, Michigan; 150 West Pleasant Avenue, Maywood, New Jersey; 5835 West North Avenue, Chicago 39, Illinois; 6214 West Manchester Avenue, Los Angeles 45, California.

FELLOWS GEAR PRODUCTION EQUIPMENT





Threading Machines

Die Heads—
Rotary & Stationary

Taps—Collapsible
& Solid Adjustable

Centerless Thread
Grinding Machines

Thread Rolling Tools

Thread Rolling Machines

LANDIS *Machine* COMPANY

WAYNESBORO • PENNSYLVANIA

THE WORLD'S LARGEST MANUFACTURER OF THREADING EQUIPMENT

coarse threads tapped at lower cost

A LANDIS ALT Collapsible Tap produces coarse pitch threads in less than a minute in one pass at the Holys Mfg. Co., 1545 S. Circle Ave., Forest Park, Ill. The workpiece is a component part for an explosion-proof rotating bronze coupling produced by Brad Harrison Co., Manufacturer Electrical Connectors, Hillside, Illinois.

JOB SPECIFICATIONS

Material: SAE 63 naval bronze casting

Thread Specifications:

Diameter	4.640"
Length	4¼"
Type	4 pitch modified square

Equipment: LANDIS 5ALT Tap with a 4-½" tap head on a No. 5 Gisholt turret lathe

This installation is an example of the "money-saving" potential of LANDIS Taps. Their ability to tap large diameter coarse pitch brass or steel threads requiring heavy metal removal in one pass reduces threading time. "Built to take it" construction assures years of productive service and allows the initial investment to be spread over a long period. Detachable tap heads give wide range coverage, keeping tool investment to a minimum (the 5ALT Tap illustrated covers a range of 1⅝" to 6⅝" with 9 tap heads). Futhermore, LANDIS Precision Tap Chasers produce a maximum number of pieces between grinds with less down time for chaser resharpening. These features all contribute to reducing the actual "per piece" tapping cost.

For more complete information on other design features and the various sizes of ALT Taps for threading all diameters from 1¼" to 13¼", see your nearest LANDIS Agent or write for Bulletin G-94.

523C

LANDIS micro

feed

for grinding to your closest tolerances...automatically

MICROFEED, a new precision wheel feed, is the biggest news in cylindrical grinding today. MICROFEED, on a new Landis grinder, assures precision to extremely close tolerances on a production basis.

This radically new wheel feed automatically cancels all variables which affect precision grinder feed systems. On piece after piece MICROFEED repeats its action with unerring accuracy.

LANDIS
precision grinders

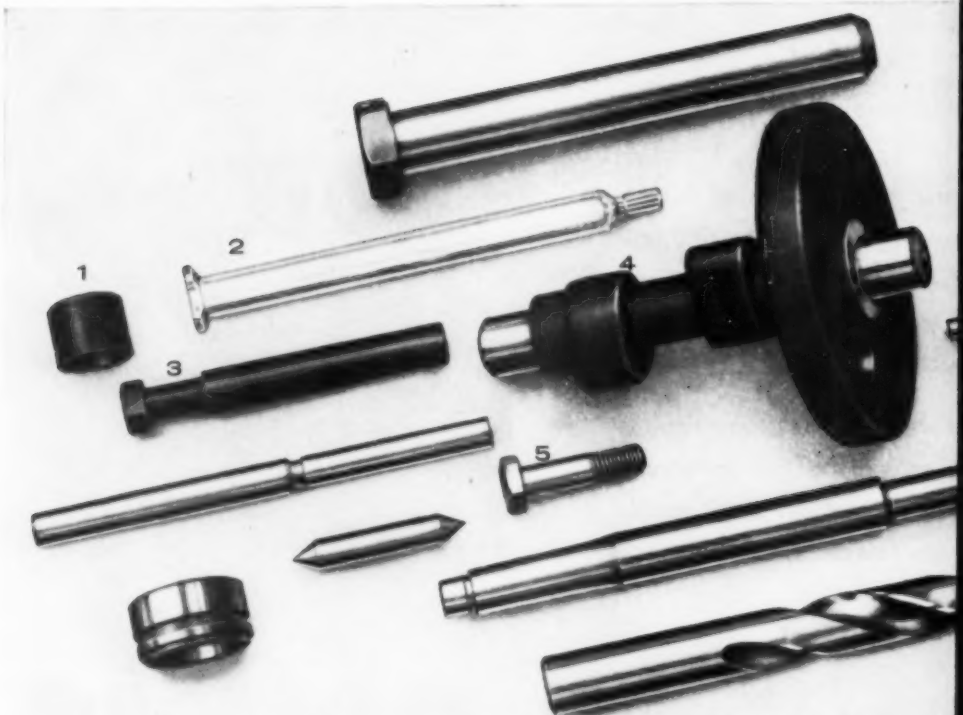
LANDIS TOOL COMPANY / WAYNESBORO, PENNSYLVANIA

1200 close-tolerance

with a

VAN NORMAN 2C *DIVERSIMATIC**

CENTERLESS



Back taper and straight shank finished ground in one pass!

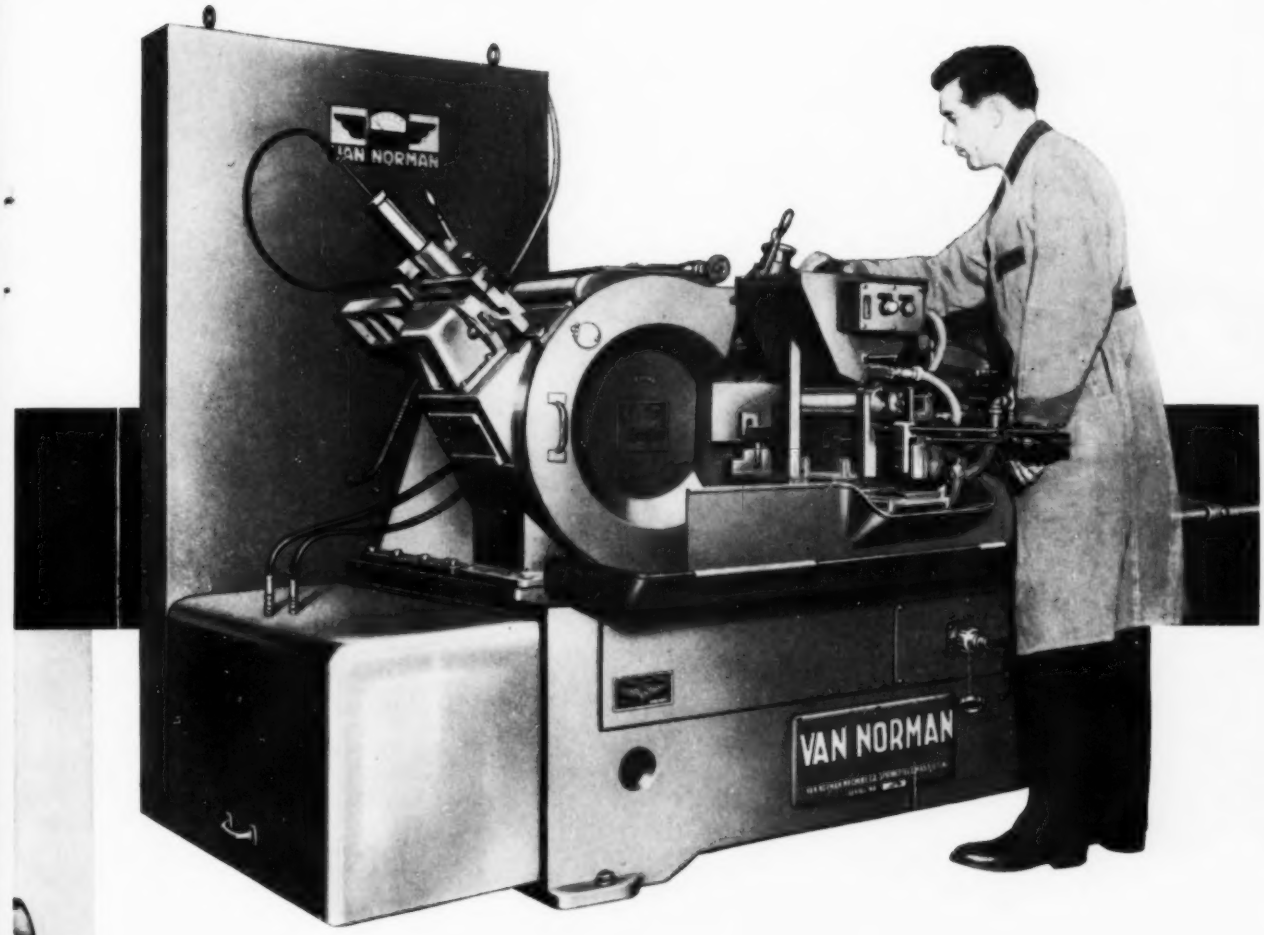
A few of the many close-tolerance parts now being volume-produced by Van Norman Diversimatic Centerless Grinders. Part #1 is made of graphite; #2, glass; #3, plastic; #4, cast iron; #5, Titanium. All other parts shown are steel.

VAN NORMAN MACHINE

SPRINGFIELD 7, MASSACHUSETTS

MANUFACTURERS OF — Ram and Column Type Milling Machines, Cylindrical Grinders, Spline and Gear Grinders, Oscillating Radius Grinders, Special Production Grinders, Centerless Grinders.

finished ½" drills per hour—



Using a 2C Diversimatic, with special automatic loading and unloading mechanisms, Morse Twist Drill, one of the country's largest manufacturers of precision twist drills, grinds 1200 high speed ½" twist drills per hour! Stock removal is .006, grinding the back taper and straight shank in one pass, maintaining tolerances of $\frac{+.0005}{-.0000}$.

Morse is but one of many manufacturers who have found that Van Norman 2C Diversimatic Centerless Grinders help them increase production and hold down production costs. Find out now how Van Norman Diversimatic Centerless Grinders can help you with your volume-production problems — write, wire or phone now for more information.

NOTE: The Van Norman 2C Diversimatic Centerless can be equipped with the exclusive Van Norman crush-former which greatly increases the range of close-tolerance parts you can volume-produce.

COMPANY

A DIVISION OF
VAN NORMAN INDUSTRIES,
INCORPORATED

VN

Don't wait . . . for extra profit install a Van Norman machine now!
They are available in many purchase plans . . . Outright sale . . .
Purchase on conditional sales contract up to five years . . .
Pay as you depreciate up to 10 years.
Conditional Sales Contracts not available to Export.

*T.M. Reg. U. S. Pat. Off.

AEROPARTS MANUFACTURING COMPANY'S
Warner & Swasey
AEROPARTS
MFG CO.

RECIPE FOR SUCCESS

Take on the Tough jobs put them on a Warner & Swasey

R. E. Radford started his company in Tulsa, Oklahoma, in 1943 with a $350.00 investment. Today, his new 40-man plant does sub-contracting on a national scale with a reputation for price and quality.

But, success was not immediate. Even as late as 1952, business prospects looked dim. Then, a man's resourcefulness plus a new kind of machine teamed up to start a literal chain reaction of success. Here's how it happened.

Radford had the idea that there was a profitable future in taking on the tough jobs that were not desirable to other companies. He also had faith to back his convictions. Now all he needed was the right machine to do the job . . . his search was a short one . . . the new Warner & Swasey 1 AC looked like the machine.

This new single spindle chucker allowed him to expand from his former policy of making screw machine parts to one involving larger, more complicated work . . . permitted him to run short cycle jobs at close tolerances of .001" and less . . . hold micro-inch finishes down to 20 RMS . . . make full use of the machine's late cross slide, flexible tooling characteristics. The dependability of this machine impressed him as much as did its productivity.

These advantages, and others that soon reflected themselves in increased values rendered to his customers, brought more business. So, another Warner & Swasey 1 AC was installed in 1954 and a third in 1955.

Today, men and management at Aeroparts maintain their high regard for their Warner & Swaseys. And in "Tex" Radford's words, "These machines were integral in the growth of this company!"

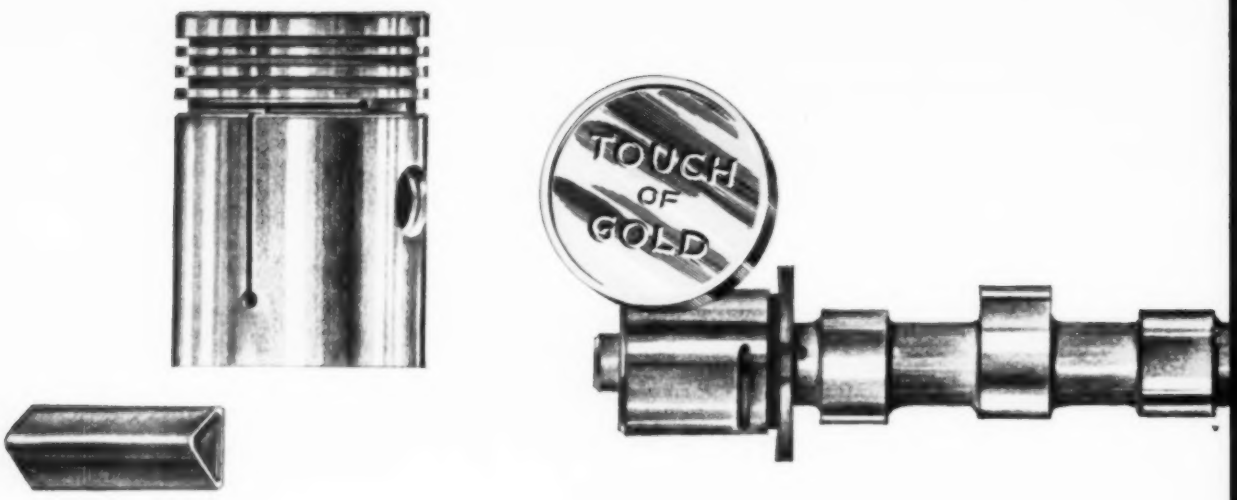
YOU CAN PRODUCE IT BETTER, FASTER, FOR LESS

. . . WITH A WARNER & SWASEY

WARNER & SWASEY
Cleveland
PRECISION MACHINERY SINCE 1880

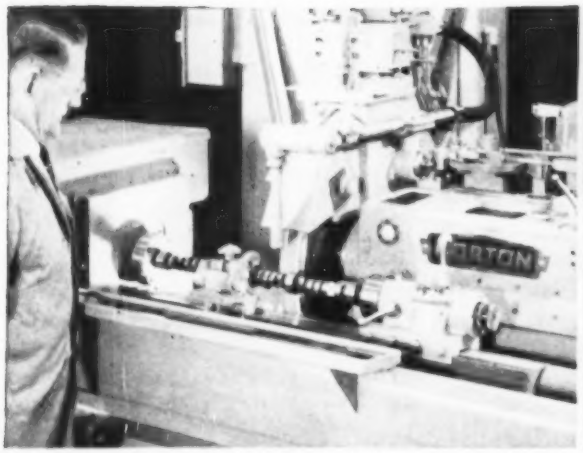
◀ CIRCLE 165 READER SERVICE CARD

CIRCLE 166 READER SERVICE CARD

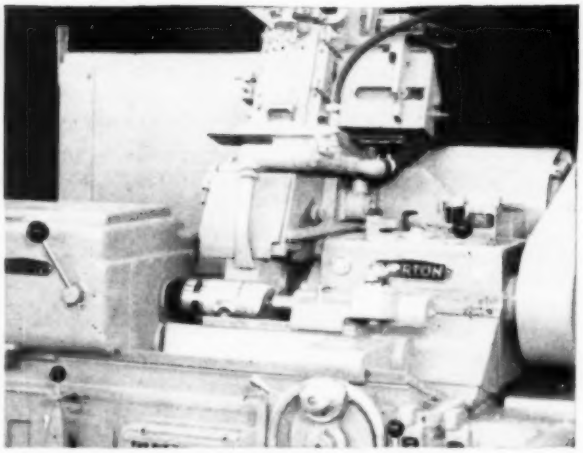


If you grind
special shapes . . . like these

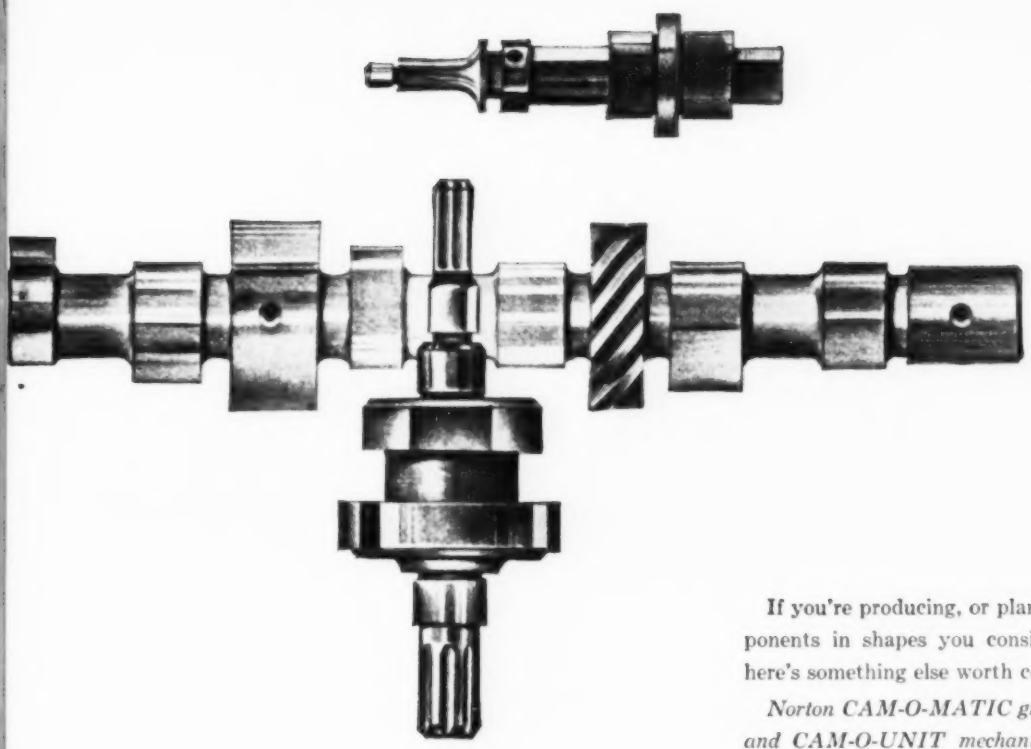
Check the special advantages of Norton grinders . . .



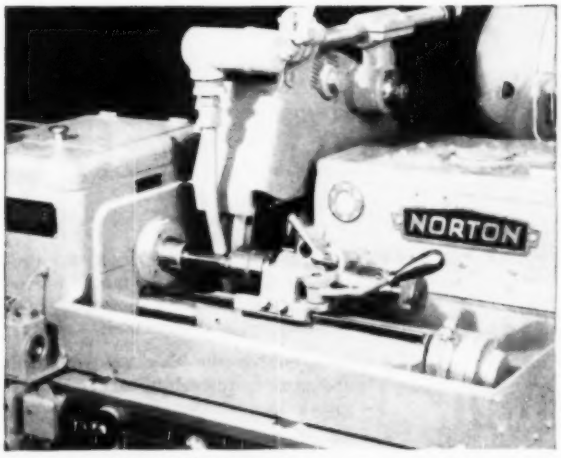
With a Norton No. 3 CAM-O-MATIC® Grinder, you grind all cams and the eccentric on an automotive-type camshaft automatically, in one handling. Automatic wheel truing and a patented device for grinding cam tapers in one or both directions are among the features that improve contour, finish and production rate.



A Norton 6" x 8" Semiautomatic Piston Grinder adds extra speed and economy to your grinding of elliptical pistons. Mechanism arrangements enable you to grind complex ovality into the skirt of a piston, as shown, or to produce standard ovality or different amounts of relief over a wide range.



. . like these



Norton CAM-O-UNIT* Mechanisms, made in varying work capacities, are particularly valuable for extending the proved advantages of Norton CTU cylindrical grinders to the grinding of cams, elliptical pistons and many other forms. The CAM-O-UNIT mechanism shown is attached to a 6" CTU to grind the three faces of a carbide tool bit.

If you're producing, or planning to produce, components in shapes you consider difficult to grind, here's something else worth considering.

Norton CAM-O-MATIC grinders, piston grinders and CAM-O-UNIT mechanisms are engineered to handle a wide range of cam and shape grinding . . . including endless variations of square, triangular, oval and many-sided forms . . . and to provide the exact forms and tolerances you need with fast, trouble-free performance that will lower your operating costs.

Shapes you can produce on this special grinding equipment include not only arcs but curves and tangent flats in combination. Your Norton Man, a trained grinding engineer, will be glad to give you expert help in selecting and operating grinding equipment that will bring you top-quality, low-cost results on the toughest jobs. NORTON Company, Machine Division, Worcester 6, Mass. District Offices: Worcester, Hartford, Cleveland, Chicago, Detroit. *In Canada:* J. H. Ryder Machinery Co., Limited, Toronto 5.

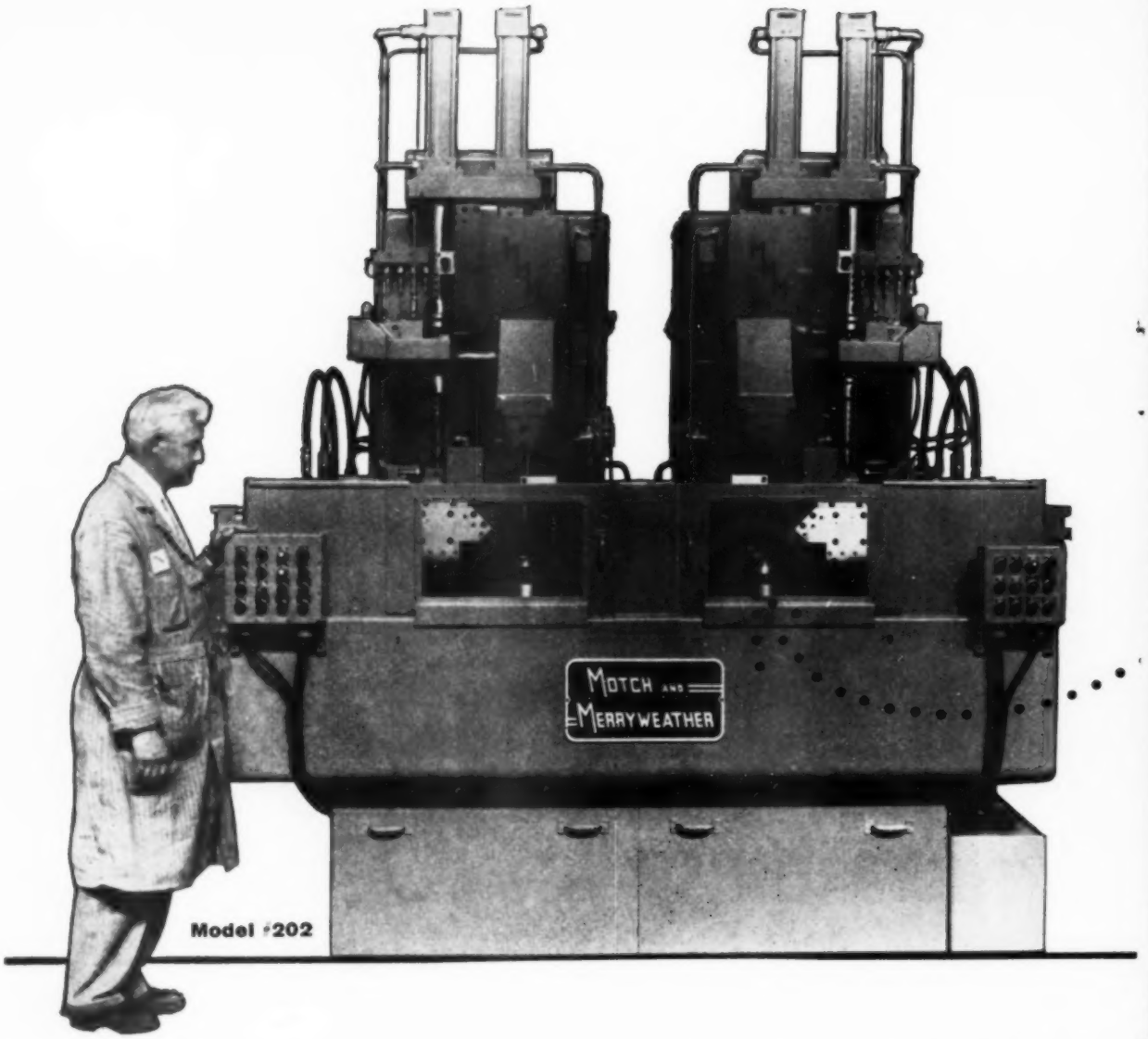
*Trade-Marks Reg. U.S. Pat. Off. and Foreign Countries

NORTON

GRINDERS *and* LAPPERS

Making better products
...to make your products better

NORTON PRODUCTS: Abrasives • Grinding Wheels • Grinding Machines • Refractories • Electro-Chemicals — **BEAR-MANNING DIVISION:** Coated Abrasives • Sharpening Stones • Pressure-Sensitive Tapes

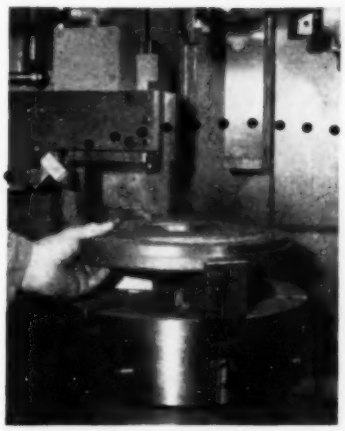


MOTCH & MERRYWEATHER'S

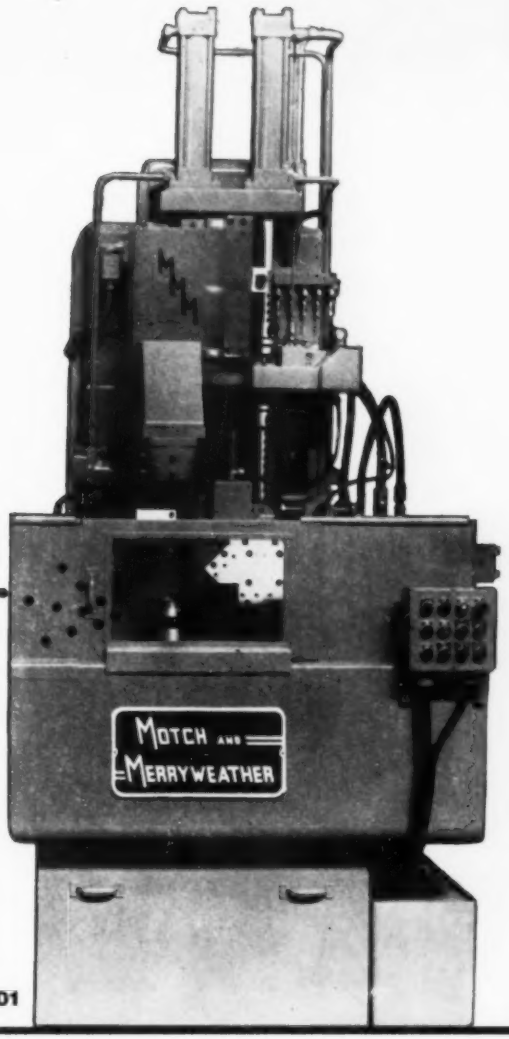
...add flexibility to standard machining operations

Here's a machine tool designed for precision turning, boring and facing operations with versatility for long and short run production jobs. Features:

- **spindles will accommodate any type chuck including air operated draw bar (20" swing) —spindle speeds adjustable.**
- **automatically-lubricated tool slides.**
- **slide ways of hardened and ground steel with tapered gibs for accurate alignment and easy adjustment.**
- **hardened adjustable slide stops.**
- **hydraulic or cam-actuated slide-feed, rapid traverse and rapid return.**



Boring, facing, and turning—to 20" —is accurately handled on the new M&M Series #200 Vertical Turners.



Model #201

#200 VERTICAL TURNERS

- separate controls for each spindle and slide unit to permit their independent operation on two-spindle machine (single spindle machines available).
- on four-spindle, two column machine, spindles are controlled in pairs, separate controls for each pair.
- "building block" design for easily-made tooling and slide changes to accommodate a wide variety of work.
- design features accessibility for simple, speedy maintenance of spindles, motors, hydraulic cylinders and/or cams and slides for minimum downtime.
- three position automatic turret available for boring, counter-boring, etc.

We can show you, in detail, how this new adaptable metal-working machine will improve your present machining operations. Call your nearby Motch & Merryweather representative, or write: Motch & Merryweather Machinery Company, 1250 East 222nd Street, Cleveland 17, Ohio.

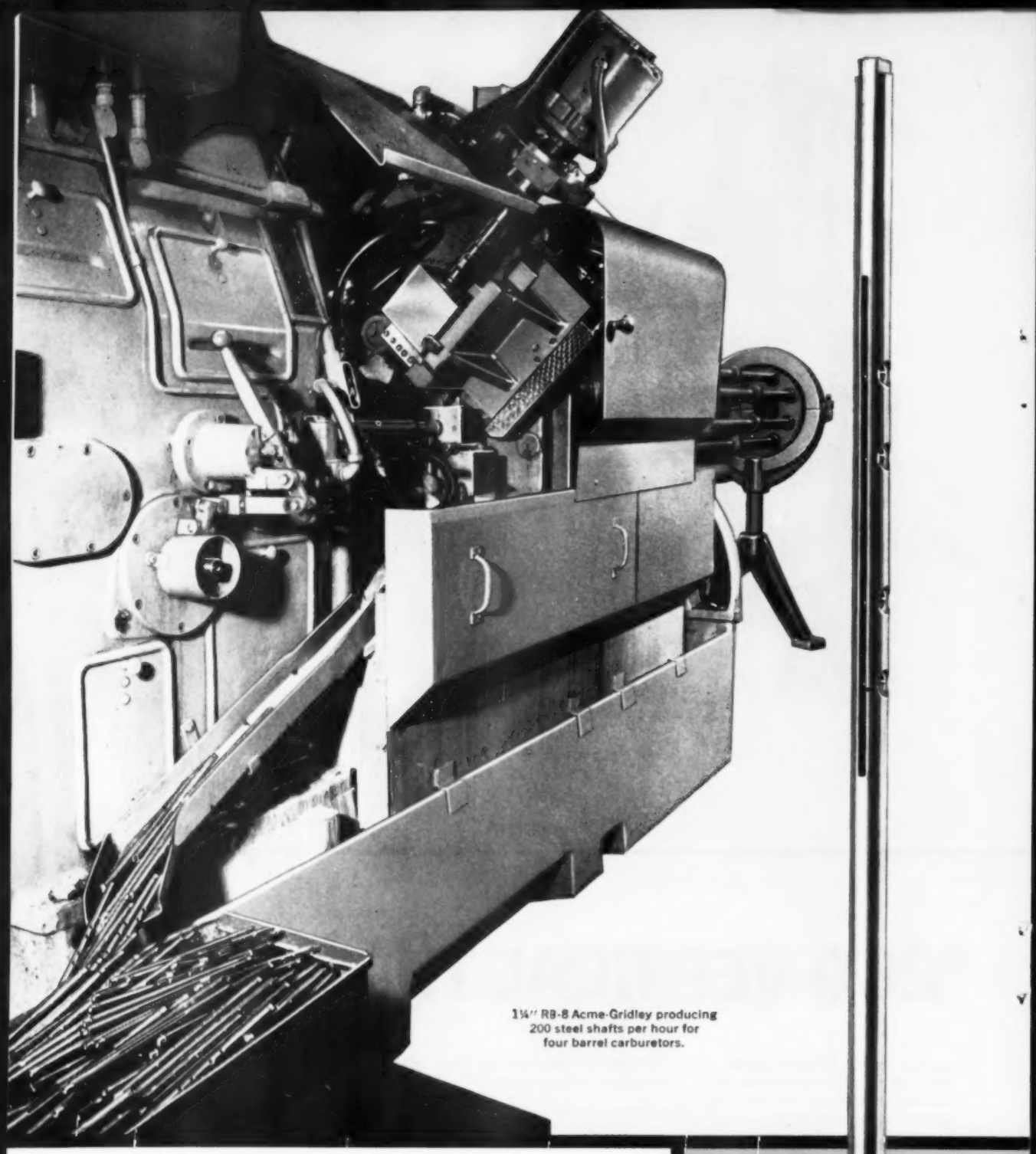
MOTCH AND MERRYWEATHER

Machine Tool Manufacturing Division
Cutting Tool Manufacturing Division
CLEVELAND
Avey Division, Cincinnati

BUILDERS OF AUTOMATIC PRECISION CUT-OFF, MILLING, DRILLING AND SPECIAL MACHINERY

▲ CIRCLE 170 READER SERVICE CARD

CIRCLE 171 READER SERVICE CARD ►



1¼" RB-8 Acme-Gridley producing 200 steel shafts per hour for four barrel carburetors.

NATIONAL ACME'S "ZONE OF RESPONSIBILITY"

INCLUDES ALL PHASES OF COST REDUCTION

Check YOURS . . . Then Check National Acme

Direct Costs: these include direct dollar savings as realized by Carter Carburetor . . . an "every day" job for Acme-Gridleys.

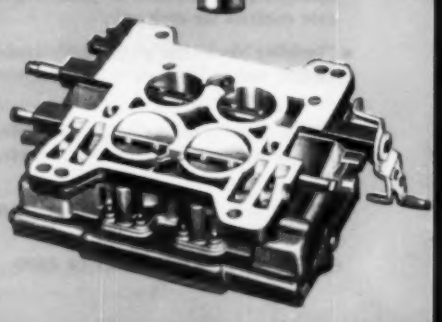
Indirect Costs: effecting important savings in maintenance, downtime, scrap reduction, tool costs, etc.

Product Redesign: teaming with your design group to take full advantage of Acme-Gridleys' cost reducing capabilities.

Direct Material Costs: our engineers provide important savings in this area by constantly matching machines and tools to modern metallurgical problems.

Make-or-Buy Reviews: in many cases our Contract Division can assume your production headaches and relieve you of immediate capital investment.

Spot Modernization: pioneering in modern tooling methods, and the flexibility of Acme-Gridleys can provide many "on-the-spot" savings.



Versatile Acme-Gridley produces

EIGHT DIFFERENT PARTS

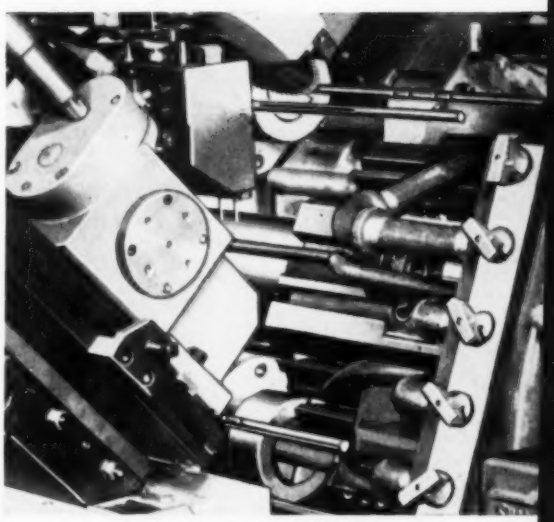
With Only Minor Changes in Tooling Setup

***For Carter Carburetor** division of ACF Industries, Inc.*

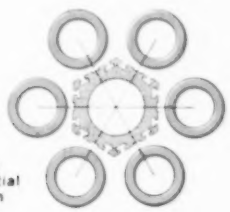
Here's machine tool versatility at its best . . . versatility that provides documented cost savings for Carter Carburetor year in and year out. Machine investment and cost-per-piece are greatly reduced. Illustrated is but one example.

The spindles of a standard 1¼" RB-8 spindle Acme-Gridley bar automatic were locked against rotation with a simple spindle locking device. Each spindle functioned as a work holder when the machine indexed from position to position. The inherent accuracy of Acme-Gridleys assured precise alignment of the work with the standard and special attachments . . . whether it's the first or last piece in the run. When spindle rotation is desired, the locking device is simply removed and replaced by the spindle drive gear.

Check the industry's most modern approach to tangible cost reduction. Call, write or wire today!



Close up of tooling zone showing milling of slot in 4th position.



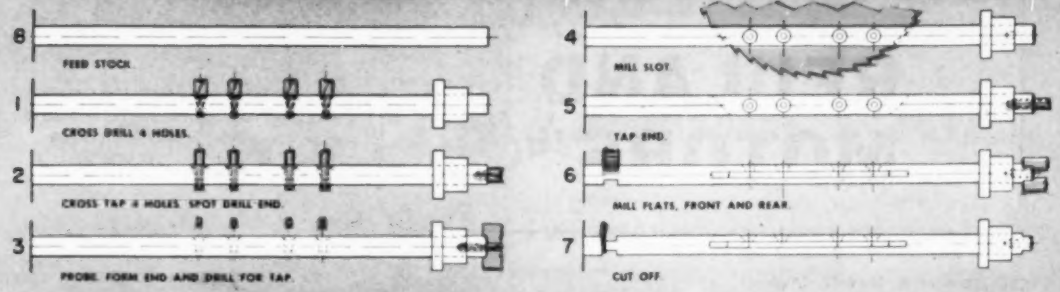
Pioneer in Circumferential Automation

National Acme

THE NATIONAL ACME COMPANY
171 E. 131st STREET
CLEVELAND 8, OHIO

Sales Offices: Newark 2, N.J.; Chicago 6, Ill.; Detroit 27, Mich.

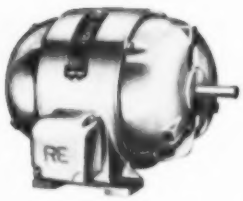
16 Operations



WHO BUT REULAND

WOULD OFFER AN

HONOR SYSTEM MOTOR SERVICE POLICY?



15-Year-Old Service Policy Takes the Word Of Any Local Electric Motor Service Shop of Your Choice

Here is another indication of Reuland quality... and the extent to which our company stands behind its products. It is based on a trust in people, and a trust in Reuland workmanship. It has met the test of time, and captured the acclaim of Original Equipment Manufacturers... and *their* customers.

Whether *your* company is an O.E.M., or a User, the Reuland Honor System Service Policy can be your passport to uninterrupted machine operation. If you are tired of delays while service responsibility is determined... if you would like to talk to a motor company that can look you straight in the eye and be measured, your experience with Reuland could be a revelation.

A free copy is available on request. Explains the simple steps to take. Shows how Reuland's unique philosophy of doing business permits it to offer the industry's only Honor System Service Policy! All company officials should have a copy. We'll mail yours promptly.

MODERN POWER FOR MODERN DAY PRODUCTS
...all in lightweight aluminum frames!

REULAND MOTORS

REULAND ELECTRIC COMPANY
WESTERN DIVISION: *Alhambra, California*
EASTERN DIVISION: *Howell, Michigan*
Distributors in all Principal Cities

For important Reuland Engineering data refer to Sweet's 1959 Product Design File, section 5a

◀ CIRCLE 172 READER SERVICE CARD

▲ CIRCLE 173 READER SERVICE CARD

Your best buy in small surface grinders

built to Landis precision grinder standards

- low first cost
- dependable accuracy
- unit construction for easy inspection and maintenance
- big machine capacity

  12" capacity under a 12" wheel

  a full 150 square inches of surface area

  grind deep with accuracy—3½" under head to bottom of wheel

Send for new catalog of Landis Abrasive Surface Grinders

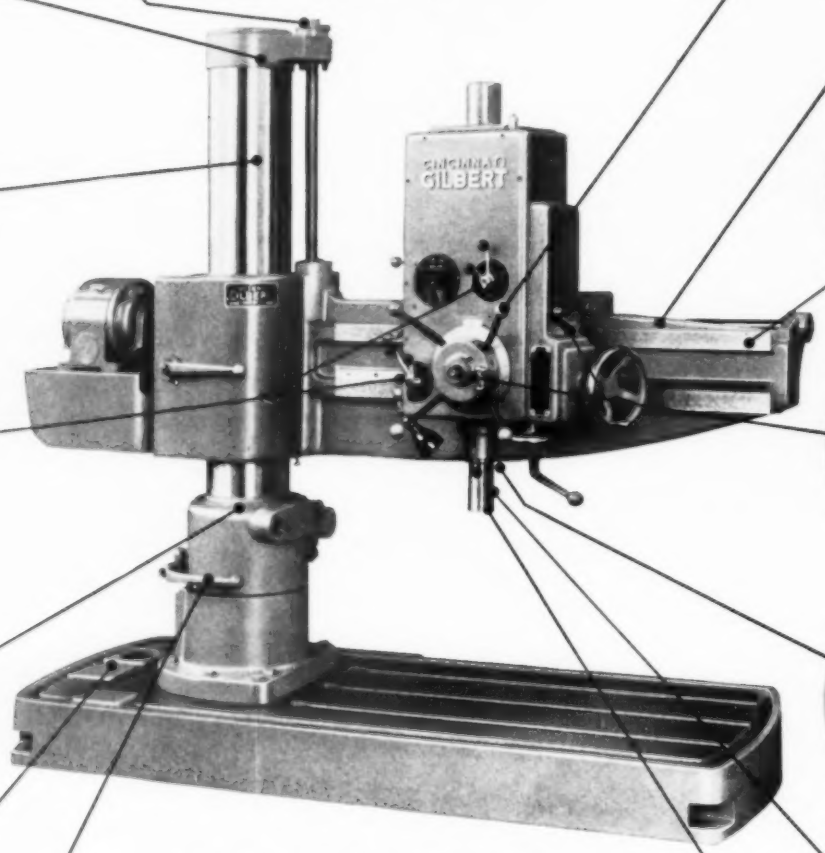
ABRASIVE
precision surface grinders

a product of
LANDIS TOOL
world's largest manufacturer of precision grinding machinery
WAYNESBORO, PENNSYLVANIA

ONLY GILBERT RADIALS

OFFER ALL THESE FEATURES

When you order a Cincinnati Gilbert radial, you get more new features per dollar than any other radial can offer. And every feature is designed to give you maximum return on your investment—in performance, productivity, and dependability.



Safety elevating nut protects both operator and machine

Weight carried on opposed Timken bearings

Hardened column available

Direct-reading speed and feed shifters; gears counterbalanced for easy shifting

Adjustable ball bearing rollers on hardened ring for maintained rigidity

Long heel on heavy base provides 360° stability

Powerful, accurate electric column clamp available

Four-lever turnstile cuts machine handling time

Balanced arm resists torsion, compression, tension forces

Head rides on anti-friction bearings; clamps three surfaces

When disengaging positive feed clutch, spindle won't drop

Full spindle support near tool; runout is less than .001"

Hardened tang slot is an exclusive Gilbert feature

You can always see the spindle; get extra use of spindle travel

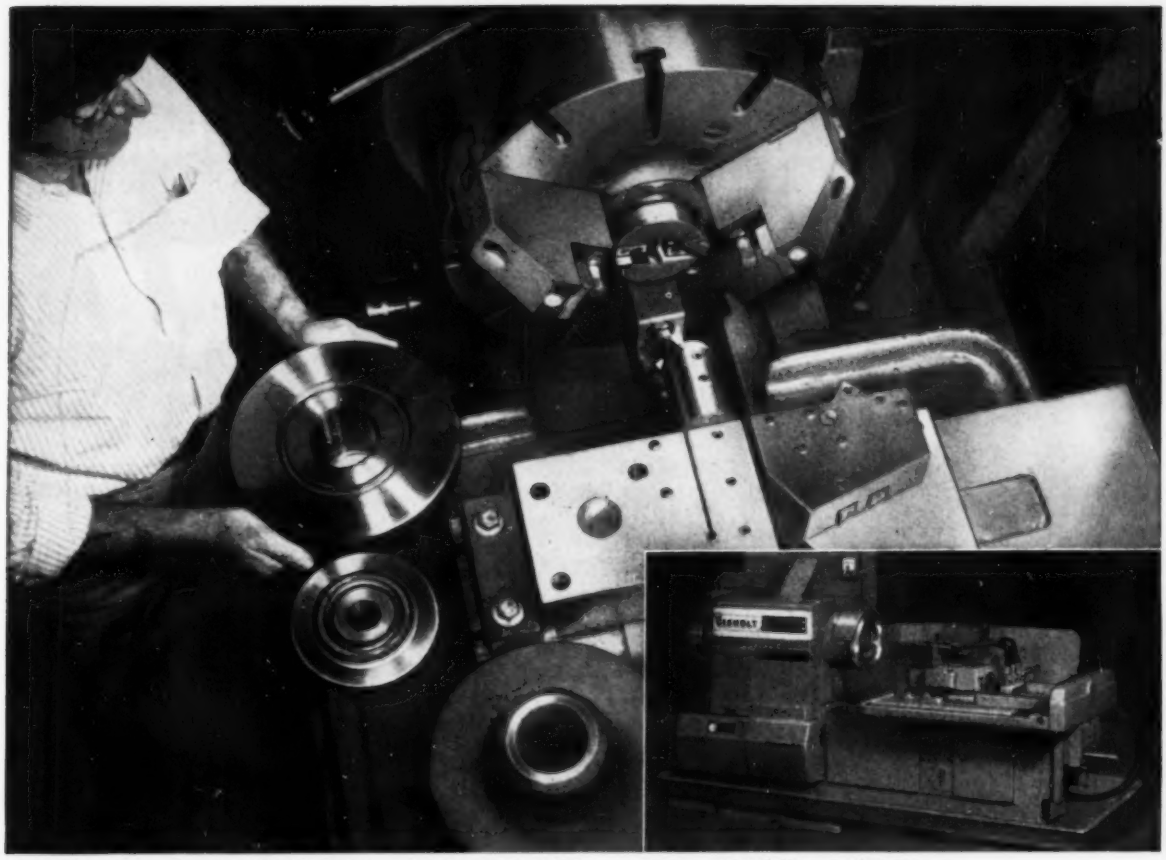
And don't overlook these additional features:

- wide range of spindle speeds for efficient tool performance;
- hardened gears throughout the machine;
- standard or special tap leads available;
- modern styling which reduces housekeeping, convinces customers that your shop is up-to-date.

Write or call for Bulletin 349.

those who buy Gilbert buy Gilbert again

THE CINCINNATI GILBERT MACHINE TOOL CO.
3340 BEEKMAN STREET, CINCINNATI 23, OHIO



Smart planning on Simplimatic holds f.t.f. time to 1.7 min. on 6½" diam., 3.3 min. on 10¾" diam. workpieces.

How OTM Corp. cuts costs machining parts in 13 sizes

Handles each part in single chucking, using Simplimatic with back-facing attachments and two-speed motor

You may get ideas from the way OTM Corporation, Houston, Texas, machines steel welding neck flanges and welding necks—with each part in 13 different sizes—completing each part in a single chucking and holding change-over time to an absolute minimum.

Here's how the job is done on a Gisholt Simplimatic Automatic Lathe: Facing, grooving, boring and chamfering operations are performed from tools on short tool slides, with T-slotted tops for quick adjustment. Relieving the boring tool at the end of the cut eliminates tool tracks. Simultaneously, a special back-facing attachment works through the spindle to shave-face and chamfer the O.D. on the hub. A power chuck wrench operates the scroll chuck and permits mounting this attachment in the spindle bore. A two-speed motor provides correct surface speed and permits switching from high speed (for turning and facing) to low speed (for grooving operation) and back again, during the Simplimatic's automatic machining cycle.

Here, again, the Gisholt MASTERLINE Simplimatic Automatic Lathe saves a manufacturer the cost of a special machine. Its extra wide platen table provides ample space for an infinite number of slide and tool arrangements—and its table feed permits tools to engage with the work or perform additional machining operations before actual slide movements begin. Ask your Gisholt Representative to show you how the Simplimatic performs special machine functions at standard machine prices—on your product and under your production conditions.

MASTERLINE GISHOLT SINCE 1887 GISHOLT

GISHOLT MACHINE COMPANY
Madison 10, Wisconsin, U.S.A.

ASK YOUR GISHOLT REPRESENTATIVE ABOUT GISHOLT FACTORY REBUILT MACHINES WITH NEW MACHINE GUARANTEE

▲ CIRCLE 176 READER SERVICE CARD

CIRCLE 177 READER SERVICE CARD ►

the latest word in low cost machining

televersal

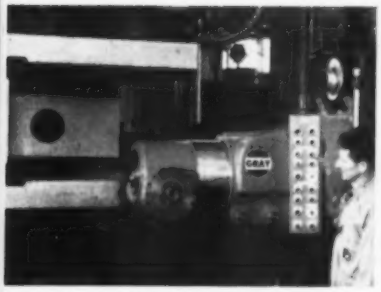
This new GRAY TELEVERSAL head tremendously increases machining range. Conveniently applied, quickly positioned, its great rigidity permits highest horsepower milling cuts.

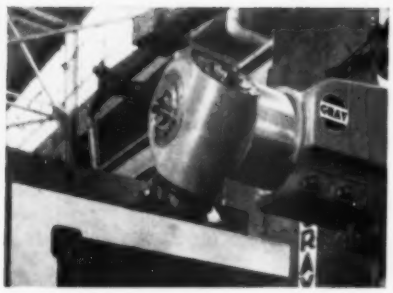
The large diameter quill may be swiveled to permit any angular cut. A triple-straddle clamp inflexibly locks the quill to the cast pyramid body.

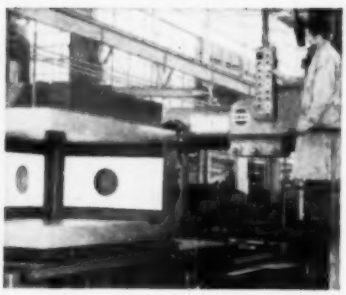
Designed to keep the job low and yet permit great machining range. Ideal when used with column cross travel of the new GRAY horizontal, boring, drilling and milling machine.

Not just an attachment, but a high power massively built, heavy milling unit that offers a new concept in versatility.

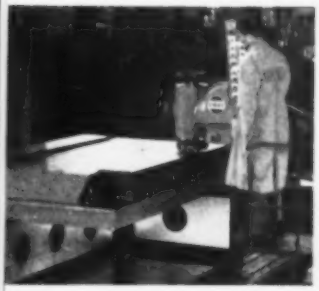
The G. A. GRAY Co., Cincinnati, Ohio

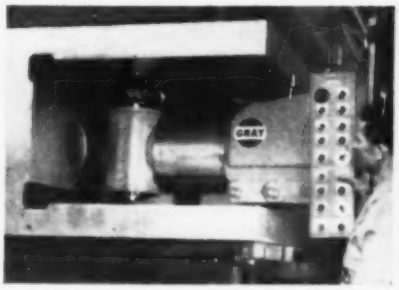


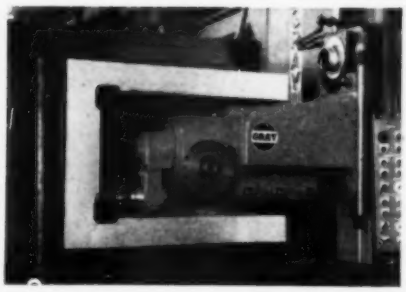


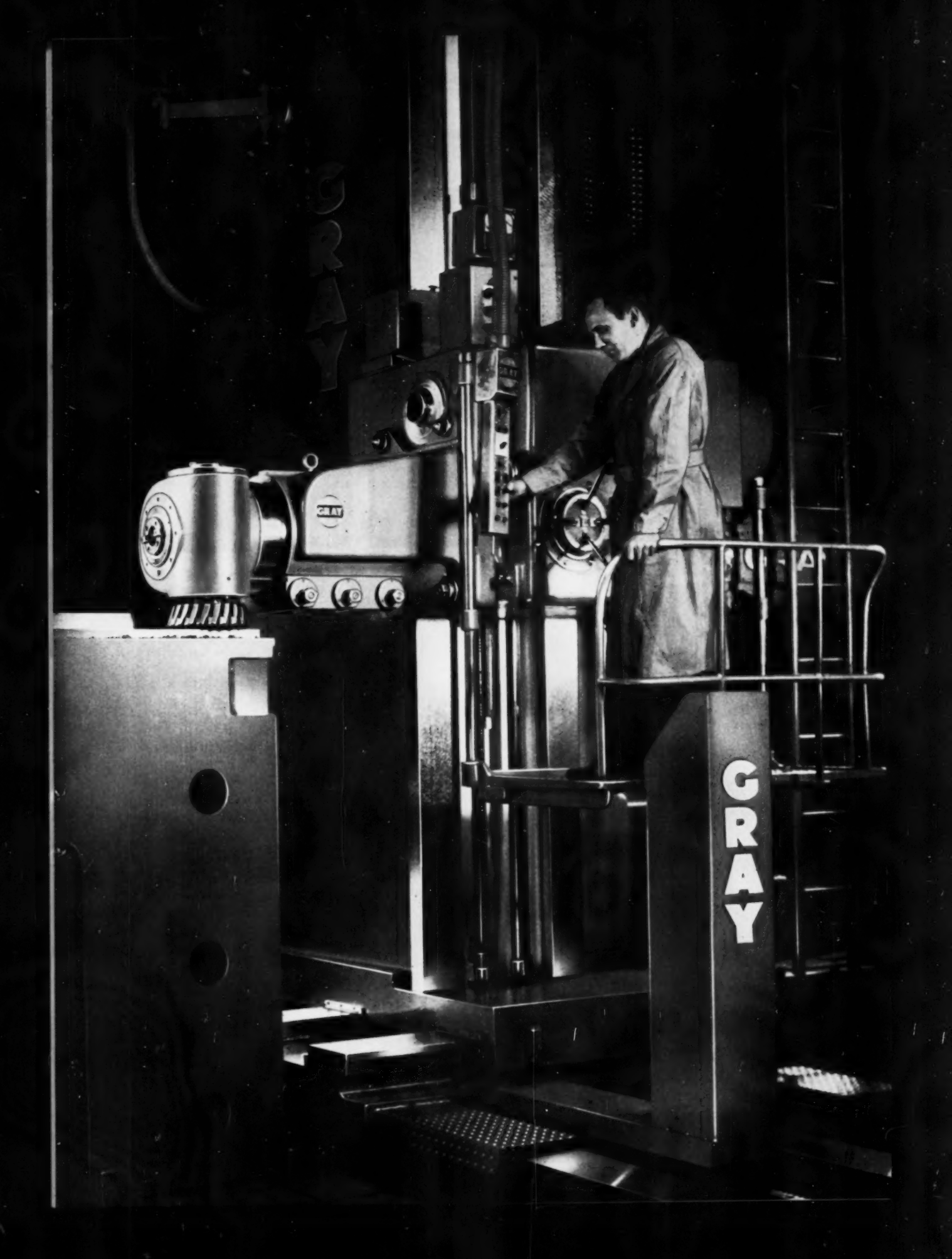


six different surfaces and more ... and only ONE work-setting

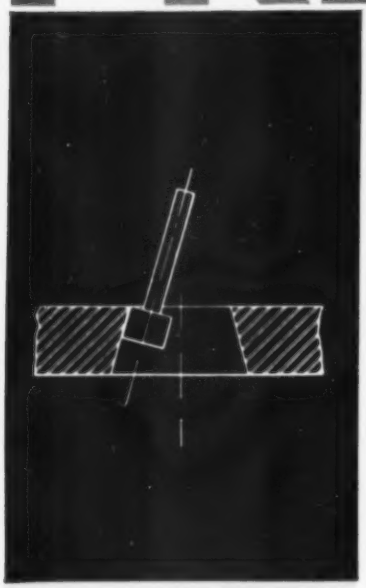




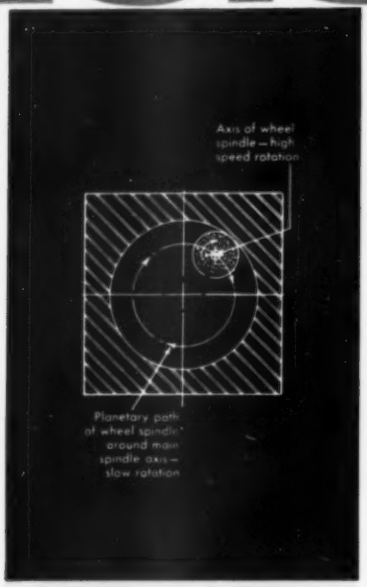



GRAY

PRECISION



TAPER
(and straight)



PLANETARY

OUTFEED wheel to grind hole, INFEED to grind O. D. of post
Axis of wheel spindle—high speed rotation
Planetary path of wheel spindle around main spindle axis—slow hand rotation

CONTOUR
(with head)

MOORE-FOSDICK JIG GRINDER

A new degree of speed, convenience and capacity is brought to precision grinding in the Moore-Fosdick Jig Grinders. This combination of the unique Moore Grinding Head with Fosdick Jig Borer Tables makes possible advantages never before available.

All standard jig grinding operations can speedily and conveniently be accomplished on the Moore-Fosdick, in addition to many which were formerly known as "trick" operations. Both straight and tapered holes can be located and ground, as well as contours consisting of radii and tangents or chordal surfaces.

The angular and indexing device built into the main spindle and the slot grinding attachment permit quick, accurate grinding of any contour, regular or irregular. Setting work on a rotary table is unnecessary except for angular surfaces. Chop grinding removes stock rapidly and makes contour grinding even faster.

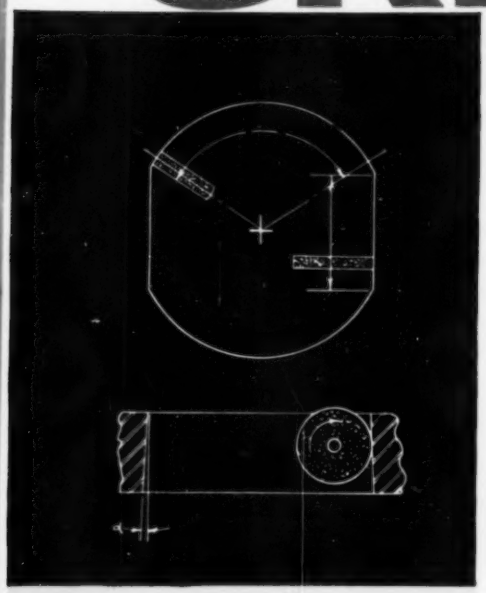
An infinite range of grinding speeds—from 12,000 to 60,000 rpm—allows accurate control

◀ CIRCLE 178 READER SERVICE CARD

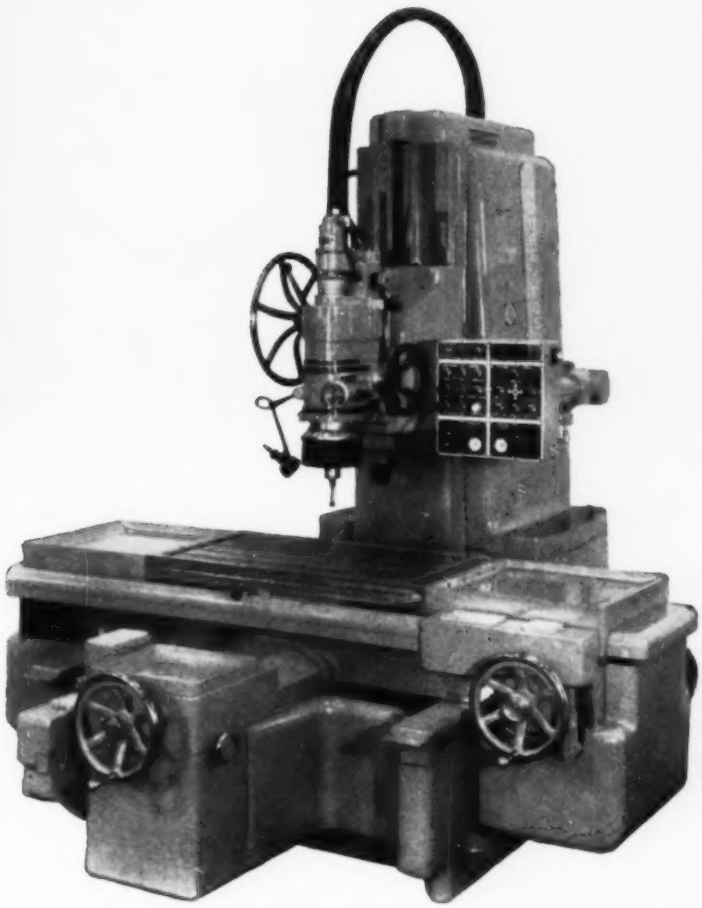
▲ CIRCLE 179 READER SERVICE CARD

GRINDING

OF LARGE WORK



CONTOUR
(with slot grinder)



of grinding and stock removal. Long-lasting precision is assured by quality construction and by many features that provide dimensional stability, including spindle-housing heat control.

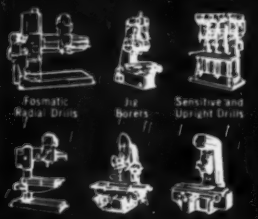
The machine may be ordered in any one of three models, one of which comes in two sizes. *All will give accuracy of ± .0001".*

Measuring is accomplished with measuring rods and inside micrometers or with Direct Dimension Measuring, where dimensions are simply set from blueprint to direct reading drum dials. Automatic positioning is also available.

Numerical control by punched tape or cards is available.

For a complete description of the various grinding operations, measuring systems and other machine features—many exclusive with Moore-Fosdick, write today for your jig grinder catalog.

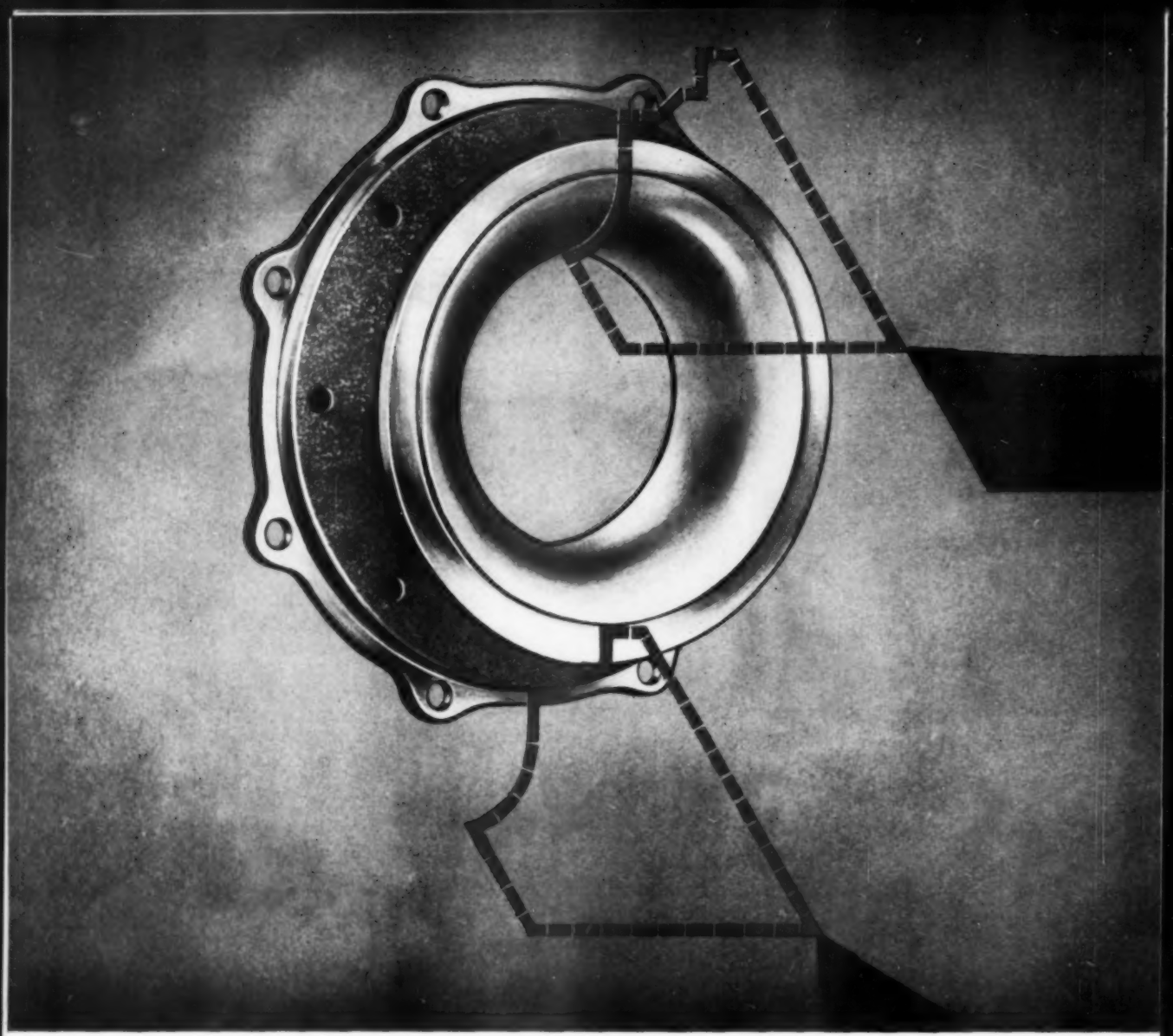
Ask for Bulletin JG-A.



NEED DRILLING EQUIPMENT?
GET A PROPOSAL FROM FOSDICK!

FOSDICK

THE FOSDICK MACHINE TOOL CO.
CINCINNATI 23, OHIO



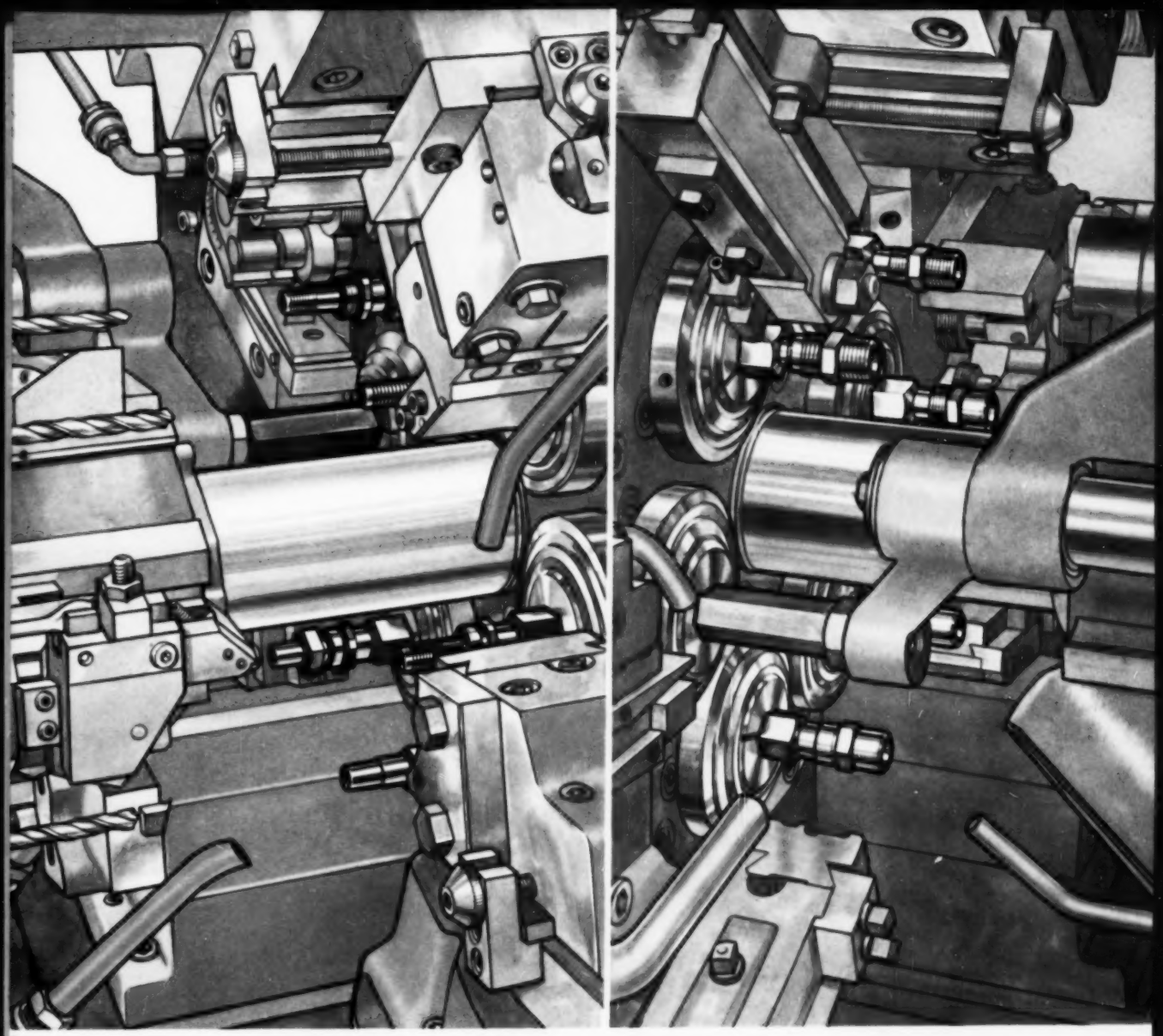
seven *surfaces to turn:* **one** *template,* **one** *slide,* **two** *tools.*

Machine tools are rarely if ever bought because somebody thinks they might come in handy. They are bought because a specific job needs to be done and because a particular machine is judged best fitted to do it. However, no matter how specific your need may be, *versatility* is the greatest by-product you can buy, and the greatest assurance of a profitable investment.

Perhaps your problem is economical, long-run production of a contoured shaft piece. Well and good: your best bet is a New Britain +GF+ copying lathe. Now let's suppose you develop a requirement for only a few hundred pieces like the one illustrated. Your New Britain +GF+ is every bit as efficient. Simple tooling; fast setup; rapid, accurate production.

The applications for contour turning are very broad. If you have contour turning, boring and facing work on shafts or chucking work, you should be interested in the New Britain +GF+. Many shops whose production requirements wouldn't justify very expensive, lightning-fast production can make highly profitable use of one of the basic models because of its versatility, accuracy, fast setup and inexpensive tooling. At the other end of the scale,

you can't touch our machines for tremendous volume work. Obviously, this subject is much too broad and too important to do justice to it here. We would like to send you literature that spells things out in much more detail. New Britain-Gridley Machine Division, The New Britain Machine Company, New Britain, Connecticut.

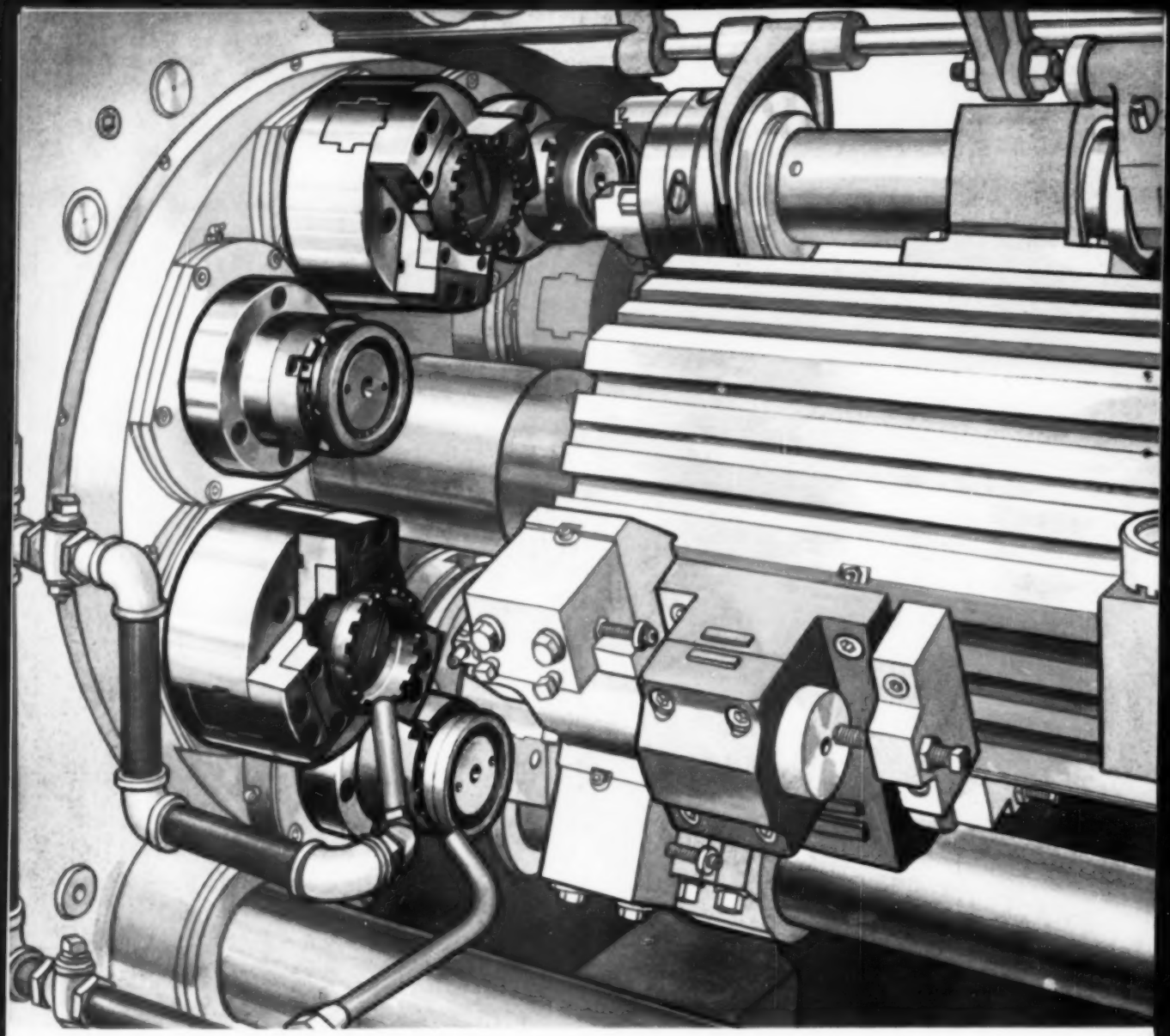


stainless, **225** *per hour—brass* **1500** *per hour.*

Up to a point increased machine productivity is a matter of refinements, additions, skillful tooling and perhaps more power. Eventually you achieve about all the efficiency that can be built into equipment of conventional design.

To achieve a major break-through in bar machine productivity necessitated redesign from the ground up. New Britain has done it with such success that we are able to offer the metalworking industry a whole new family of machines with performance unequalled anywhere. Independently cammed cross slides open up a whole new world of tooling possibilities. Power and spindle speeds are adapted to the important new metals and alloys. Increased chucking capacity allows application of New Britain standards of speed and accuracy to much larger pieces. None of the famous New Britain exclusive features which preserve accuracy and increase accessibility over other machines have been sacrificed. The chart below tells part of the story, and we have complete literature available to spell it out completely on the models which interest you particularly. New Britain-Gridley Machine Division, The New Britain Machine Company, New Britain, Connecticut.

Model	Spindles	Cross Slides	Spindle Speeds	Spindle Capacity	H.P.	Weight
45	4	4	43-526	5"	30-50	46,000
52	6	6	271-4250	1 1/4"	15-25	12,800
62	6	6	177-3000	1 5/8"	15-30	18,800
62	6	6	177-3000	2 1/4"	20-30	18,875
82	6	6	64-633	3 1/2"	30-50	46,000
83	8	6	99-1504	2 5/8"	30-50	46,000



open secret *of New Britain superiority.*

Wide-open design makes the most fundamental difference between a New Britain automatic chucking machine and other machines. It speaks for itself as a means of getting at the tooling, making adjustments and clearing chips.

Massiveness, right from the floor up, is equally apparent and equally important in chucker work. You see it in the way the cutting tools make the heaviest cuts with a chatter-free smoothness that can't be duplicated.

Only New Britain provides a combination of longitudinal with transverse forming motion where needed. This versatility eliminates the need for second operation machines in many cases —particularly when a job is setup for double indexing, as illustrated above.

New Britain spares no pains to incorporate every new development to make chucker-type machining more profitable. The open-end design lends itself particularly well to magazine loading and unloading, for example, and many New Britains are being equipped to provide this feature.

Whenever a number of operations are required on cast or forged pieces, these massive, rugged, powerful machines offer great possibilities for savings through faster, more accurate, more reliable production. A new and complete catalog on the New Britain chucker line is just off the press. We would be very glad to send you your copy. New Britain-Gridley Machine Division, The New Britain Machine Company, New Britain, Connecticut.

Announcement

New Britain's new and completely modern Rebuild-Retool Center at Bridgeport, Michigan, is important to every present and prospective owner of New Britain Automatics.

This is the first center established exclusively for the rebuilding and retooling of production machinery. It is staffed by men trained specifically for this type of work. It is equipped specially for putting New Britains back on the job with maximum efficiency in minimum time, at minimum expense to the owner.

Rebuilding and retooling may be "orphan jobs" elsewhere, but they rate top treatment at New Britain. Here is an important extra reason for selecting a New Britain when you purchase new equipment—a full time specialist organization devoted to protection of your investment.

If you would like to investigate the profit potential in a complete modernizing program, or could profit from a factory-engineered retooling of one or more machines, write us either at New Britain, Connecticut, or Bridgeport, Michigan. The New Britain Machine Company.

New Norton advancements for barrel-finishing!

TUMBLEX* abrasive now available in "RP" and "TP" pin shapes for finer, faster finishing of intricate parts

New TUMBLEX "RP" (Round Pin) abrasive, size 3/8" diameter x 5/8" length, is ideal for finishing a retainer ring with round holes on sides and ends.

New TUMBLEX "RP" (Round Pin) abrasive, 3/16" diameter x 5/8" length, is exactly the right size and shape to reach all areas of cylindrical serrated missile part with center hole.

Like the long popular TUMBLEX "T" (Triangles) and "S" (Spheres) barrel-finishing abrasives, the new "RP" and "TP" types are made of bonded ALUNDUM* abrasive — fast-cutting and lustre-giving. Their round and triangular pin shapes are particularly designed to remove burrs and improve surface finishes on parts with holes, slots, serrations and other hard-to-contact recesses — and to bring you "Touch of Gold" advantages including shortest time cycles and lowest cost-per-piece finished.

Send samples of parts you finish — large or small, simple or intricate — to our Sample Processing Department. We'll barrel-finish with the new "RP" or "TP" abrasive, or with any more suitable TUMBLEX type and tell you the abrasives, methods and equipment you need most. NORTON COMPANY, General Offices, Worcester 6, Mass. Plants and distributors around the world.

*Trade-Mark Reg. U. S. Pat. Off. and Foreign Countries

NORTON
ABRASIVES

New TUMBLEX "TP" (Triangular Pin) abrasive, 3/8" side width x 1" long, gives faster, smoother finish to slotted and notched hydraulic valve unit.

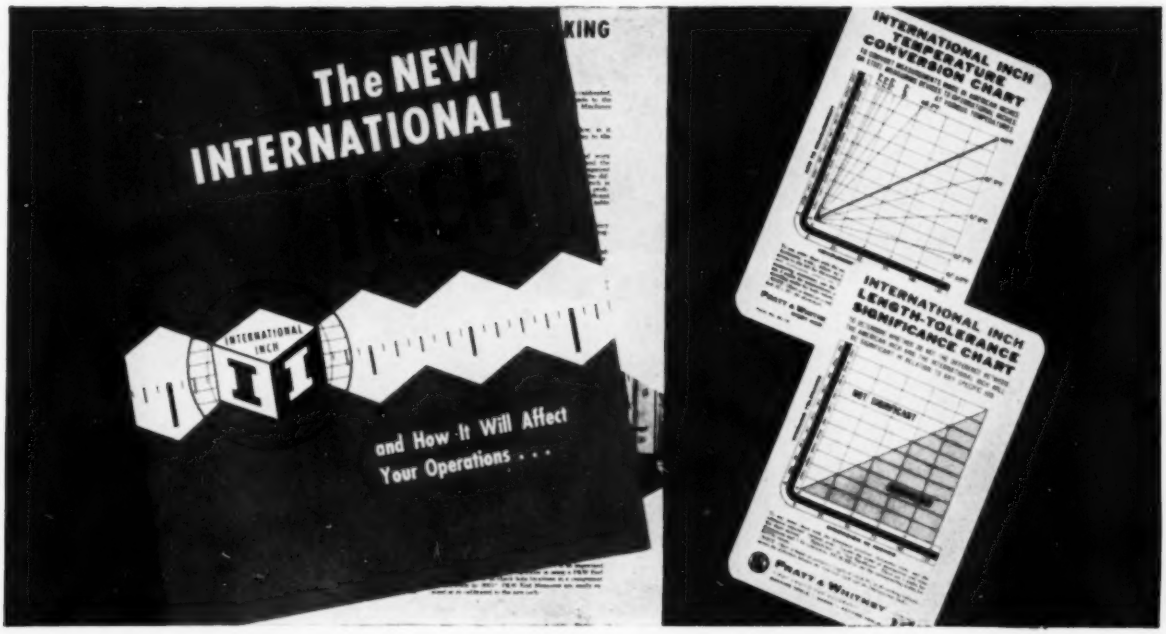
G-375

Making better products . . . to make your products better

NORTON PRODUCTS: Abrasives • Grinding Wheels • Grinding Machines • Refractories • Electro-Chemicals — BEAR-MANNING DIVISION: Coated Abrasives • Sharpening Stones • Pressure-Sensitive Tapes

ACCURACY ASSURED...

by these practical answers to your questions about—


The NEW INTERNATIONAL
INTERNATIONAL INCH
and How It Will Affect Your Operations . . .
INTERNATIONAL INCH TEMPERATURE CONVERSION CHART
INTERNATIONAL INCH LENGTH-TOLERANCE SIGNIFICANCE CHART
PRATT & WHITNEY

On July 1, 1959, the new International Inch became the *official standard* of linear measurement for The United States of America. While the difference between the old U. S. Inch and the new International Inch is small, this difference can be *extremely important* in many operations . . . for example, where large workpieces and relatively close working tolerances are involved. As a result, manufacturers like yourself are asking for a practical means of evaluating their own operations in terms of this change-over . . . and asking for practical answers to questions about altering or recalibrating gages, gage blocks and machine tools; converting measurements; and satisfying customers who ask for components produced to the new standard.

YOURS FOR THE ASKING, this new booklet by Pratt & Whitney will give you practical, common-sense answers to these questions! Also included in the booklet are charts that tell at a glance whether or not the difference between the U. S. Inch and the International Inch will be significant for any specific job . . . and provide easy instant conversion of measurements from U. S. Inches to International Inches. The same charts are also available in handy, pocket-size plastic form for use at the machine or inspection bench, or in your standards room. Your free copy of the booklet, or the pocket charts, can be obtained at the Pratt & Whitney Branch Office in your area . . . or simply fill in and mail the handy coupon below. Pratt & Whitney Company, Inc., 11 Charter Oak Boulevard, West Hartford, Conn.

PRATT & WHITNEY
FIRST CHOICE FOR ACCURACY
MACHINE TOOLS • GAGES • CUTTING TOOLS

PRATT & WHITNEY COMPANY, Inc.
11 Charter Oak Blvd., West Hartford, Conn.

Please send my free copy of:

☐ The P&W Booklet, "The New International Inch and How It Will Affect Your Operations."

☐ Pocket Guide International Inch Significance and Conversion Charts.

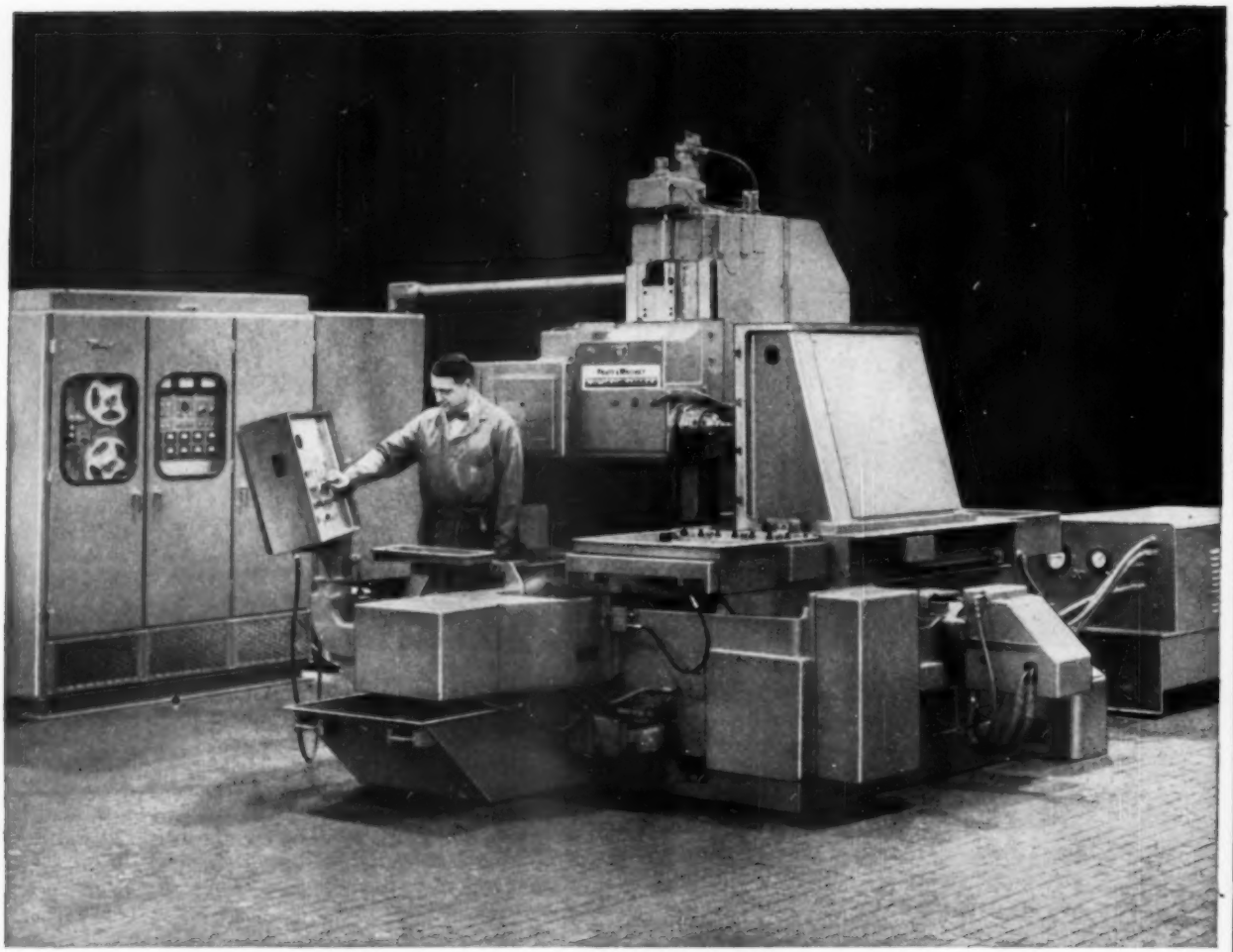
NAME_____ POSITION_____

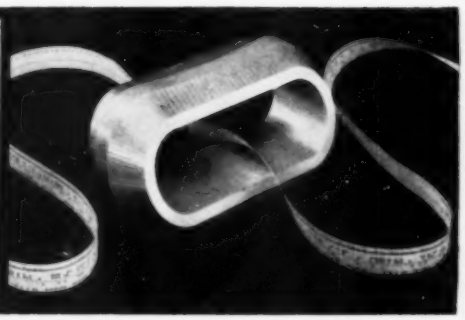
COMPANY_____

CO. ADDRESS_____

CITY_____ ZONE_____ STATE_____

ACCURACY





PER-PIECE PRODUCTION TIME CUT 33% . . . by machining these aluminum computer housings on a Numeric-Keller. Each piece required 12 pockets milled and 72 holes drilled. Scrap loss to date: zero!

ONLY 21 5 HOURS . . . were needed to machine this complicated tool steel missile part on a Numeric-Keller. Machining involved 3 roughing and finishing contour cuts and 4 roughing and finishing pocket milling cuts.

3-DIMENSIONAL MILLING UNDER TAPE CONTROL . . . is demonstrated by this vision block for a super-modern military tank. Geometry is quite complex. Tape was prepared using both computer and hand computations.

ASSURED...

...PLUS REVOLUTIONARY ADVANCES IN MACHINING SPEED, EFFICIENCY and VERSATILITY with the new

NUMERIC KELLER

TOOLING COSTS and LEAD TIME CUT AS MUCH AS 75% . . . because the P&W Numeric-Keller is equipped for continuous-path milling under the direction of a tape-reading numerical control system. Models, templates and other costly, complicated tooling are eliminated!

EXTREME ACCURACY . . . with overall production easily held to ± .001". Piece-to-piece reproduction accurate to "tenths" is possible with controlled cutter selection.

UNUSUAL VERSATILITY . . . with more different types of jobs done faster and better. Short and long runs are handled with equal efficiency. Using tape, changeover is fast and easy, with minimum time lost between jobs.

MACHINE UTILIZATION IS GREATLY INCREASED . . . because more time is spent making chips, with less time needed for setup, fixturing and other non-productive operations. Similarly, man-hours are made more productive.

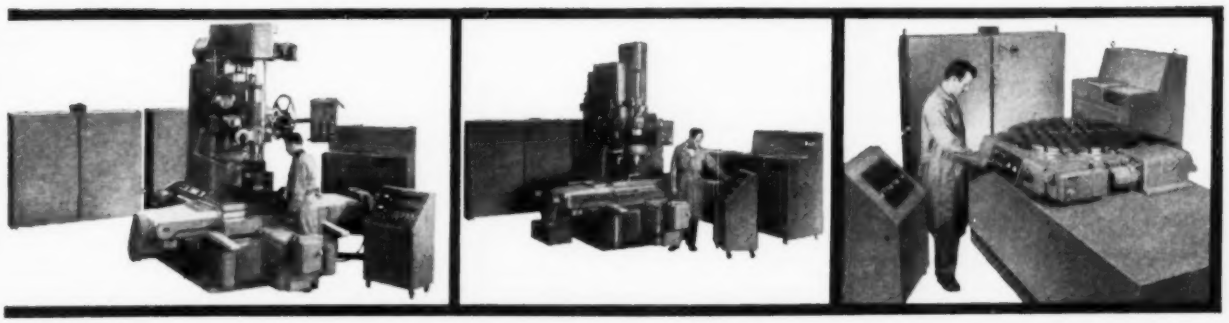
MACHINING TIME IS SLASHED . . . because tape control means maximum speeds and feeds programmed through all phases of the machining cycle. Optimum machining practice at all times also means finer surface finishes.

SEND NOW FOR THE CASE-HISTORY FACTS . . . that show how the P&W Numeric-Keller has saved *HOURS* of setup, tooling and machining time on dozens of jobs like the 3 examples shown on the facing page. See how this revolutionary machine can produce equally important savings on the toughest milling jobs in YOUR plant. Write today for your copy of Circular No. 624, that includes Job Analysis Sheets to give you the dollars-and-cents facts on Numeric-Keller savings. Pratt & Whitney Company, Inc., 11 Charter Oak Blvd., West Hartford, Connecticut.

PRATT & WHITNEY

FIRST CHOICE FOR ACCURACY

MACHINE TOOLS • GAGES • CUTTING TOOLS

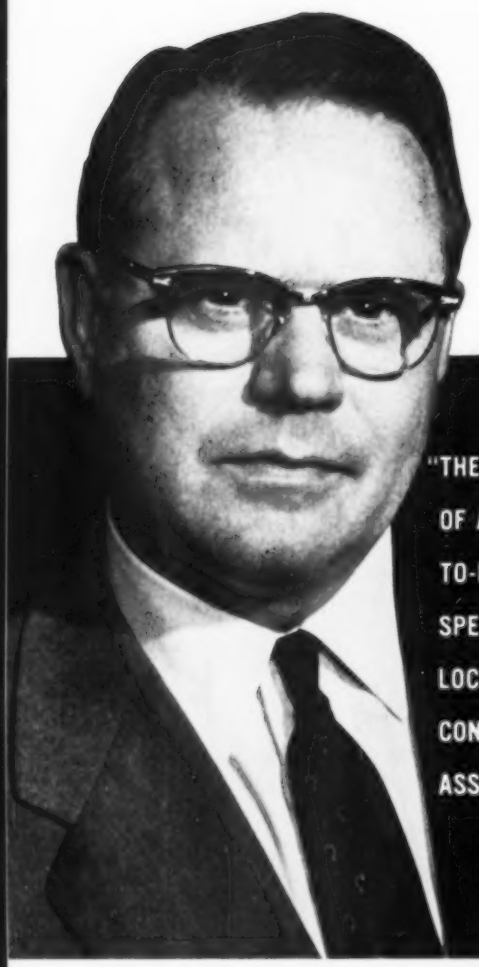


OTHER P&W NUMERICALLY CONTROLLED MACHINE TOOLS . . . include the Jig Borer, Vertical Precision Hole Grinder, and Precision Rotary Tables. Providing settings accurate to .0001", made automatically from data supplied by punched tape or operator keyboard, the Jig Borer and Hole Grinder combine toolroom precision with production-line speed and ease of operation. Equally efficient for short- or long-run production work. Ultimate in speed plus precision in circular spacing, graduating, and angular positioning, the Pratt & Whitney Numerically Controlled Rotary Table provides automatic settings accurate to 5 seconds of arc!

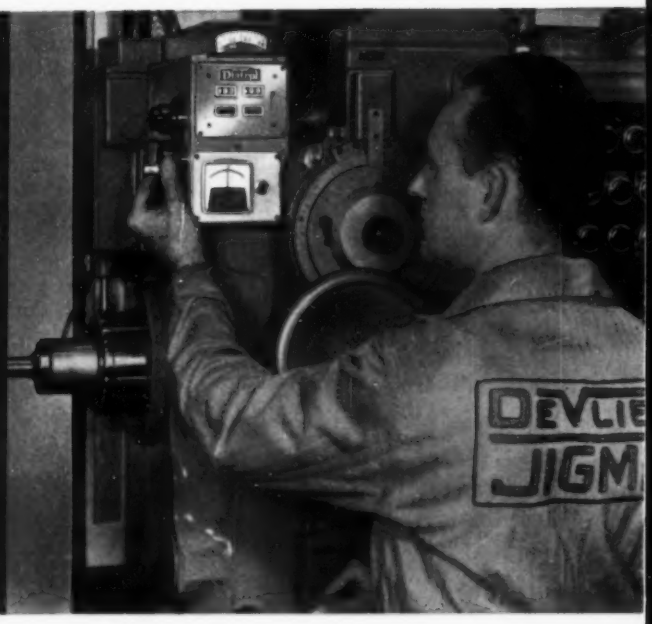
NEW FROM FAIR STREET • HOME OF THE JIGMIL

dia

direct dial dimensioning system

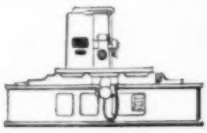


"THE DIATROL SYSTEM OF AUTOMATIC POINT-TO-POINT POSITIONING SPEEDS UP SPINDLE LOCATION, SIMPLIFIES CONTROL AND ASSURES ACCURACY"



"Simply dial in the pre-selected coordinate dimensions, touch a button, the rest is automatic. The JIGMIL table and spindle head automatically position at the desired hole location in seconds. While the JIGMIL is machining, you can *pre-set* your next move. Developed by our own engineers, Diatrol adds to the inherent versatility and accuracy of the JIGMIL, further reducing human error as well as set-up and machine time. *Diatrol makes it possible to machine custom or small lot jobs at production rates.*"

C. R. DE VLIEG



DEVLIEG MACHINE COMPANY, FAIR STREET • ROYAL OAK, MICHIGAN

trol®

for DeVlieg Spiramatic Jigmils

Simple! Accurate! Automatic! Diatrol is a transistorized electro-mechanical system, simple in design and simple to operate. All settings are made on direct reading dials; one dial for horizontal, the other for vertical dimensioning. Direct dialing of positive or negative dimensions is possible from any arbitrarily selected datum plane or zero point within the range of the system. Coordinate dimensions can be fed direct from the blue print, eliminating much of the mathematics formerly required for accurate jig boring. Measurement and positioning accuracies are controlled to one-ten-thousandth of an inch. Developed exclusively for the JIGMIL, Diatrol is now available for the complete range of JIGMIL precision boring and milling machines. For complete information, write or arrange a visit to Fair Street.

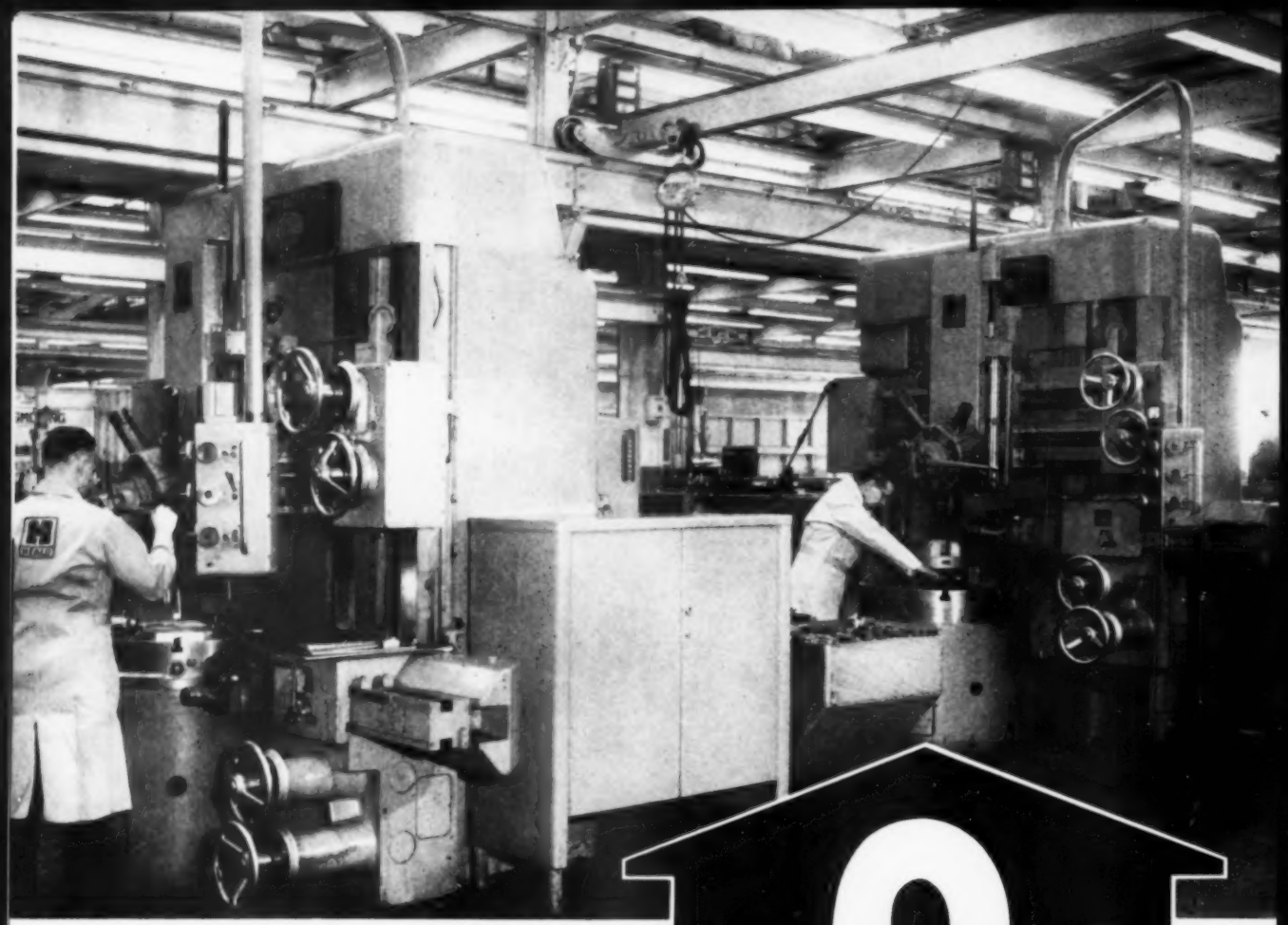
Rewarding revelations in precision await your visit to Fair Street

..... HOME OF THE JIGMIL

DeVlieg

SPIRAMATIC JIGMILS®

ACCURATE HOLES AND FLAT SURFACES IN PRECISE LOCATIONS



IT PAYS TO REPLACE . . .

A study of the production factors at The Heald Machine Company, Worcester, Mass., pioneer New England builders of precision machine tools, indicated that two Bullard Cut Master V.T.L.'s, Model 75, would produce as many parts, in any given period, as four Bullard V.T.L.'s of an earlier design.

when 2 do the work of four

In actual production, these additional advantages have been experienced:

- Greater flexibility for faster changeover and set up
- Ease of control — less operator fatigue
- Dependability and accuracy on holding size
- Less tool wear, spoilage and inspection
- More rigidity for higher speeds and feeds

This all adds up to more parts at less cost per piece.

Perhaps an analysis, by a Bullard Sales Engineer, of your machining procedures will reveal "hidden savings" for you.

Why not ask him or write.

BULLARD

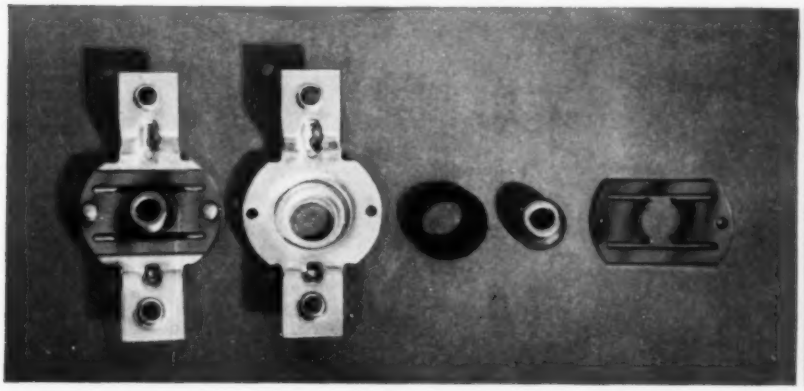
THE BULLARD COMPANY

BRIDGEPORT 9, CONNECTICUT

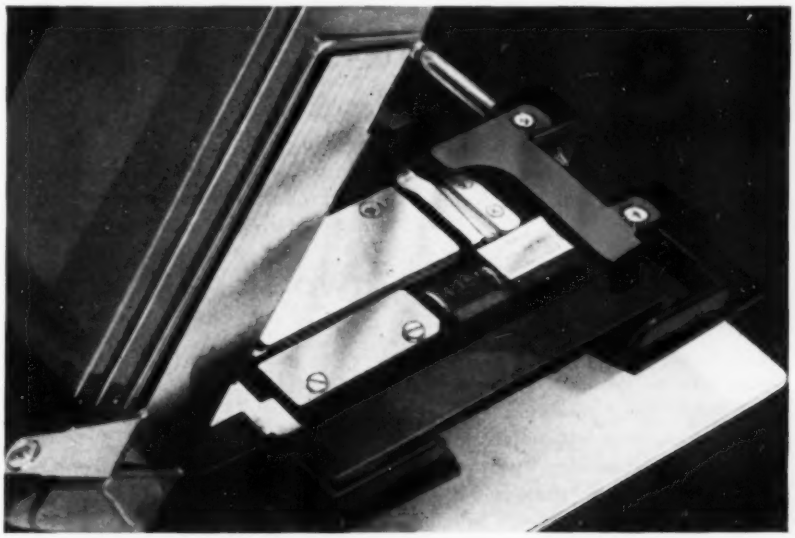
CIRCLE 191 READER SERVICE CARD

NEW BRONZE
CAN CUT SPRING COSTS—

Superfine-grain phosphor bronze by Anaconda now handling many tough jobs, replacing costlier materials.



RETAINING CLIP for a bronze bearing in the Handy Hannah Hair Dryer was originally of spring steel. Rejections ran 20% in the stamping operation and another 20% at the assembly stage. The Handy Hannah Products Corp., Whitman, Mass., switched to Duraflex, Anaconda superfine-grain phosphor bronze, found it had not only the spring quality and fatigue resistance needed for the job—but also had superior formability which eliminated rejections.



SPRING CLIP takes a steady beating as it holds invoices in place in imprinting machines—used widely in handling charge accounts by retail stores and service stations. In the imprinter (right) made by the Farrington Mfg. Co., Needham Heights, Mass., this clip was originally of beryllium copper. Hearing about the superior fatigue life and endurance limit of Duraflex, Farrington consulted Anaconda technical specialists and decided to try it. Duraflex has been doing the job now for two years, stands up in service, saves $1.50 a pound in material cost.

TESTS by an independent laboratory show that design stresses for Duraflex wire and flat springs can be from 33% to 50% higher than for those made from regular phosphor bronze—yet Duraflex costs no more than regular phosphor bronze. Get the test reports and revaluate all your components requiring spring properties. For copies of these reports or technical help in selecting the right alloy and temper, see your Anaconda representative. Or write: The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ont. 5945

DURAFLEX®

SUPERFINE-GRAIN PHOSPHOR BRONZE

A PRODUCT OF

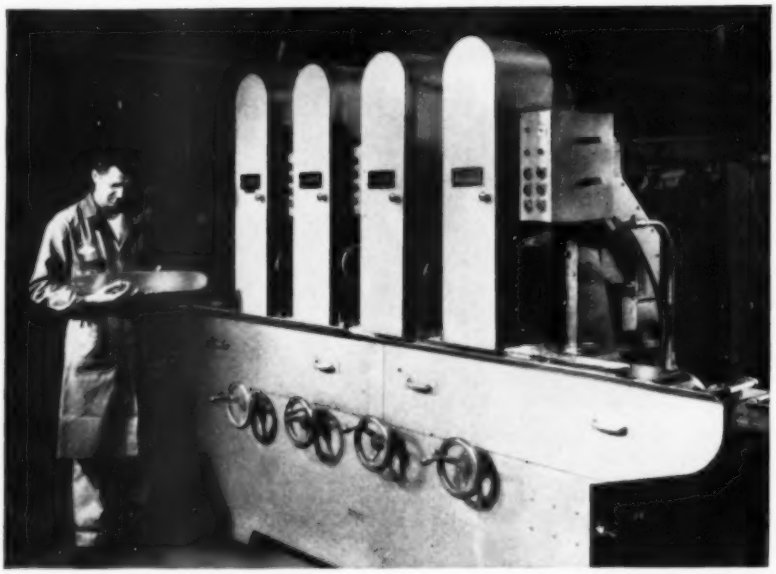
ANACONDA®

Made by The American Brass Company

SUNDSTRAND *"Engineered Production"* NEWS

NOW... it's SUNDSTRAND-ENGELBERG for precision abrasive belt grinders

A complete range of precision abrasive belt grinders formerly built by Engelberg, Inc. is the newest addition to the expanding line of Sundstrand machines for the manufacturing industries. Sundstrand's manufacturing, engineering, and machine design experience is being applied to abrasive belt machining aimed at expanding the already broad list of operations on which the process has been applied with outstanding results. Included in the Sundstrand-Engelberg line are single and multiple head machines for deburring, flat-surfacing, sizing, fine polishing, etc., as well as centerless grinders. They offer real machining capacity going far beyond mere polishing. Multiple head machines perform all the steps from roughing to fine polishing in a single pass.



Steel chain saw bars are precision sized and finished in single pass on four-head machine. Stock removal is .005 inch.

Standard machines are available with 6-, 8-, 10- or 12-inch belts and machines with 3 to 6 heads may be canted to cut obliquely to each other to produce mirror-like finishes. Cool operation with practically no chance of parts distortion due to overheating, high production rates, maximum operator safety, easy maintenance, and extreme versatility are outstanding attributes of Sundstrand-Engelberg grinders. Production workers with minimum skills can be quickly trained to handle machines in the line.

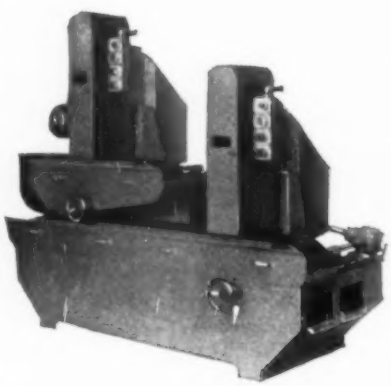
TWO-SIDE GRINDING

Extreme flexibility offered by abrasive belt grinding is illustrated by this machine. Both sides of a workpiece can be ground on this Sundstrand-Engelberg machine without special fixtures or without any handling or repositioning. Work passes under head at left, then is carried around to bottom conveyor belt for finishing second side.

Standard components are used for the bed and grinding heads, thus holding down both engineering and manufacturing costs.

Outstanding production records include one that boosted production of hardware parts by 1000%. This was done by using a specially designed rubber fixture belt with a two head machine to replace a three step process.

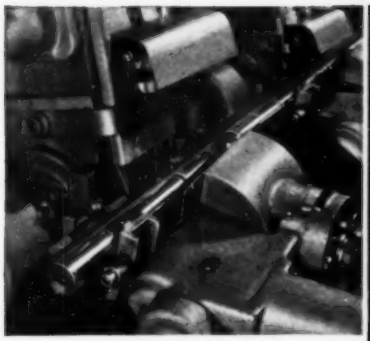
Another machine for finishing typewriter parts has four grinding heads used in vertical and horizontal sequence to grind four sides of the part, followed by two wire brush-heads that deburr milled slots in opposite sides of the rack.

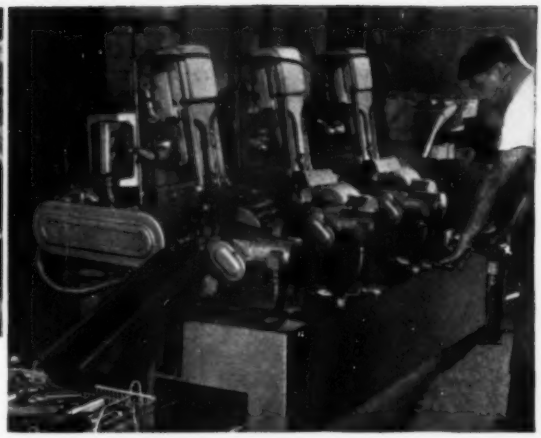


Copper-clad sheets for computer have .0002-in. removed from each side. Production jumped sixteenfold to 400 per hour.

"Engineered Production" Service

SUNDSTRAND





Three-head machine has socket wrench parts fed automatically. Workpieces of varying lengths and diameters are ground to diameter tolerance within .002 inch using vibrator feeder.

CENTERLESS GRINDER

Economical, highly accurate centerless grinding of a broad array of parts is being handled on Sundstrand-Engelberg abrasive belt centerless grinders. One or more grinding heads may be used depending on the nature of the part and production rate required. The relatively simple building up of machines by adding workheads holds equipment costs low, when a multiple-head unit is necessary.

Typical parts successfully handled include motor and cylinder shafts, brass tubing, tool parts, electronic components, atomic fuel elements, etc. Surface finishes of 4 microinches and tolerances of less than .001-inch at thru-feed rates as high as 35 feet per minute have all been recorded.

Automatic feed devices are available where required by nature of work being processed. Unusual flexibility to accommodate wide range of workpiece diameters is inherent in design of the machines.

SIMPLE ADJUSTMENT, FAST CHANGEOVER

Extreme simplicity of setup and operation offers opportunity for major economies on Sundstrand-Engelberg grinders. Magnetic chucks beneath each grinding head hold work firmly on conveyor belt, depth of cut is controlled by handwheels that raise and lower grinding heads. Micrometer adjustment of head position is provided at rate of .010-inch per turn of handle.

Abrasive belt tension is easily set and adjusted for various types of belts used. Belts have long life as they provide both length and area needed to dissipate heat. Flexing of belt keeps it clean, reducing need for frequent belt changes.

Changing abrasive belt and setting tension is a simple one-man job. Once set, tension remains constant throughout operation.

Handwheels with micrometer adjustment raise and lower grinding heads for accurate setting of depth of cut.

GET MORE DATA

Additional facts about the application of abrasive belt machining are available in this booklet. *Write today for your copy, ask for bulletin 107.*

SUNDSTRAND MACHINE TOOL

DIVISION OF SUNDSTRAND CORPORATION

BELVIDERE, ILLINOIS

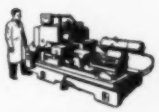
SUNDSTRAND

More facts about

SUNDSTRAND

"Engineered Production"

Literature listed under various machine types has more details. Write Sundstrand for your copy today.

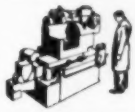


Automatic and Tracer Lathes
Bulletin A-107

Engineered Milling Production
Bulletin B-107

Examples of Transfer Machines—Bulletin C-107

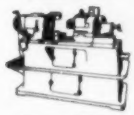
Multiple-spindle Drilling Machines—Bulletin D-107



Internal and Rotary Surface Grinders—Bulletin E-107

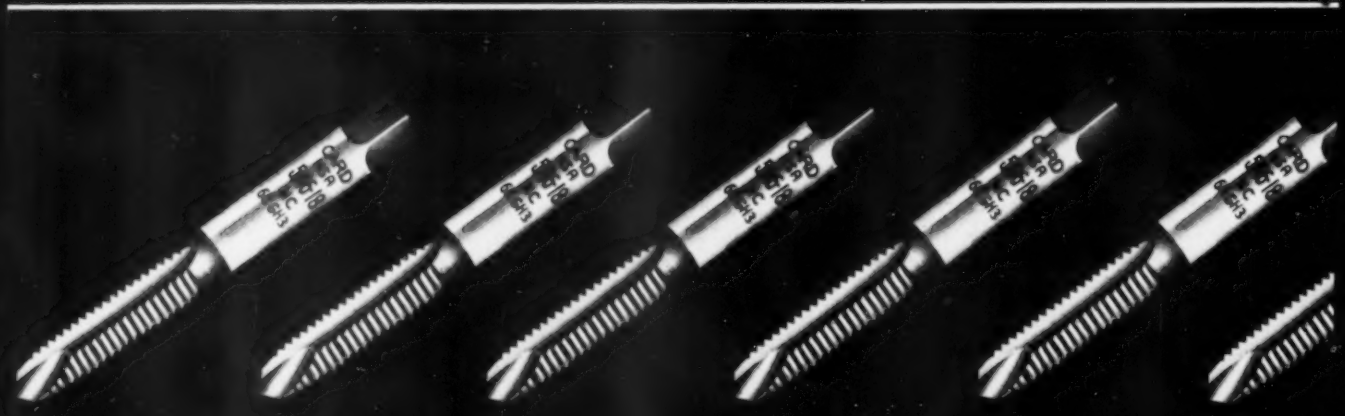
Practical Broaching Methods
Bulletin F-107

Broaching Tools
Bulletin F-107



Thread Milling
Bulletin G-107

When you see uniformity remember . . .



With Card spiral pointed taps you get uniformity

Your production's consistent ...because Card taps are uniform

. . . And they're always readily available to meet your production schedules. To this end, Card Division maintains a network of warehouses across the country. Inter-connected by teletype, these strategically located supply centers give your Card Distributor fast, efficient service. He's always ready for your jobs. You get the exact type of Card tap you need . . . in any quantity . . . at any time. Your Card technical man has complete details on Card taps, dies, and gages. S. W. CARD DIVISION, Mansfield, Mass.

Card Warehouses: Atlanta, Chicago, Detroit, Fort Worth, Los Angeles, New York, San Francisco.

CARD

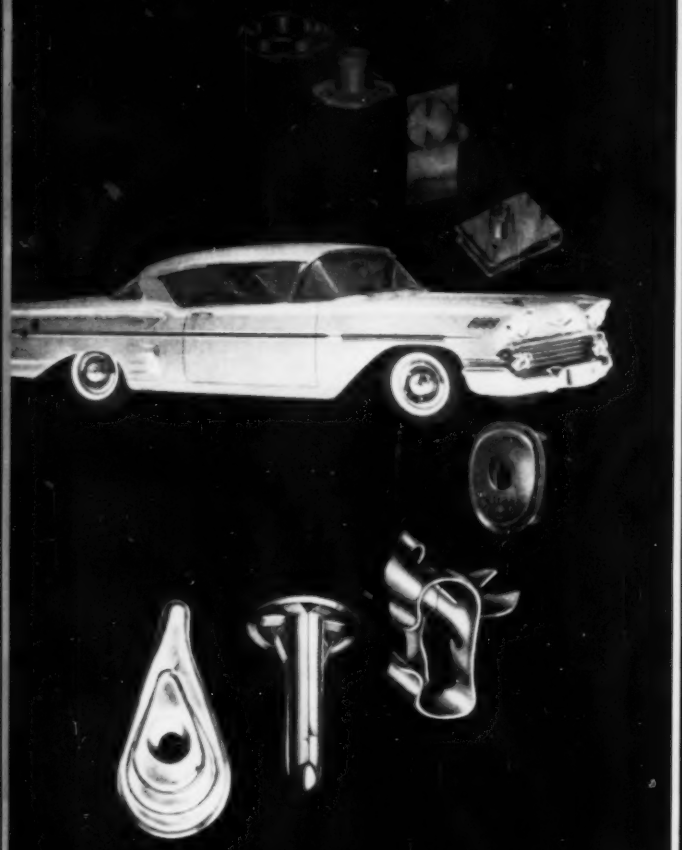
DIVISION OF UNION TWIST DRILL COMPANY

— Serving you through the best distributors from Coast to Coast

▲ CIRCLE 195 READER SERVICE CARD

CIRCLE 196 READER SERVICE CARD ►

If you use carbide milling cutters as much as automobiles use fasteners . . .



Ordering Union carbide milling cutters will cut your production time and costs

The more you use carbide milling cutters the more you need Union

Union carbide milling cutters are typical of Union progress — in carbide tool development and in increasing the variety and versatility of milling cutter types. In plants throughout the country Union technical men have proved that the time and costs of many production operations can be reduced with Union carbide milling cutters and other Union carbide tools, as well as Union drills, end mills, reamers, hobs, inserted blade cutters, gear cutters and milling cutters.

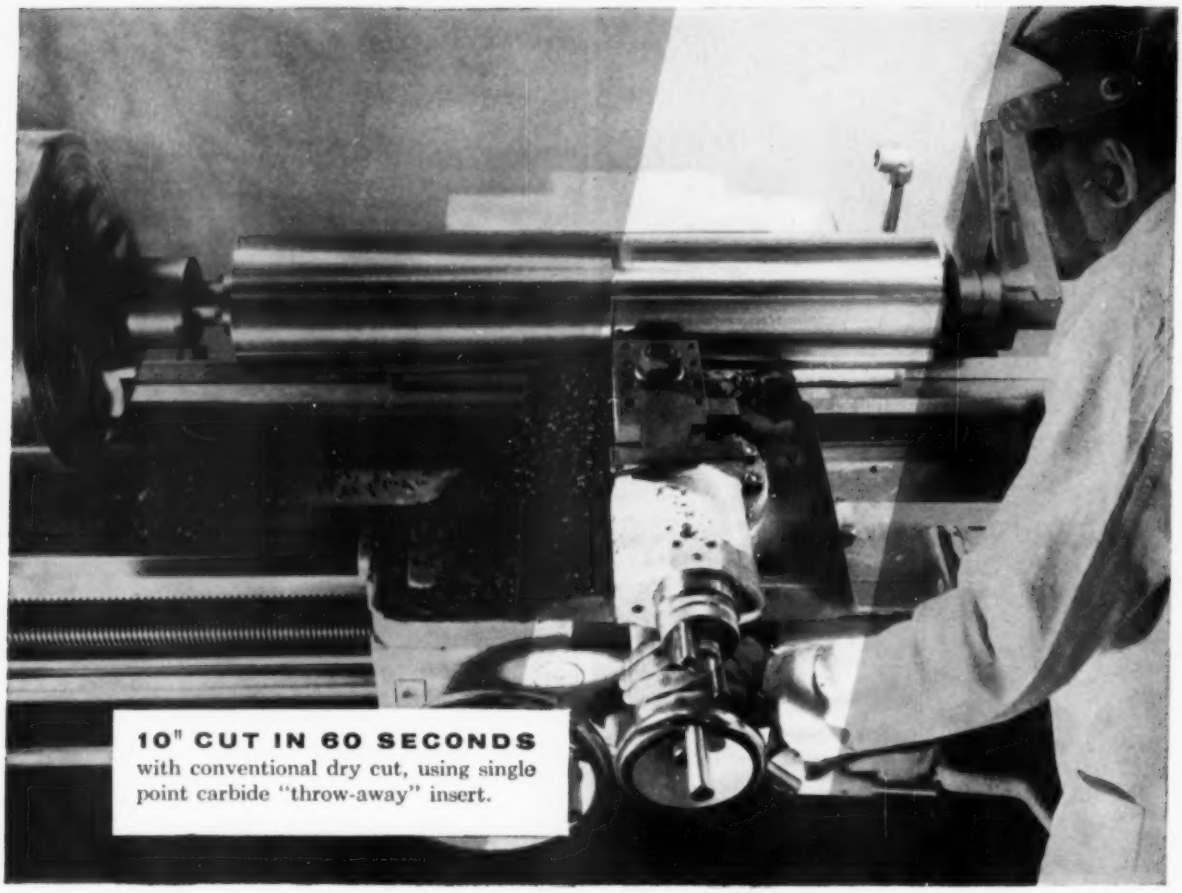
Available nationally through Union Distributors and stocked in Union warehouses in Atlanta, Chicago, Detroit, Fort Worth, Los Angeles, New York City and San Francisco.

UTD

UNION

TWIST DRILL COMPANY, Athol, Massachusetts

S. W. CARD DIVISION, Mansfield, Mass.; BUTTERFIELD DIVISION, Derby Line, Vt.



A new cutting fluid that

with any single-point

Shell's experience in the last 3 years proves that Shell Dromus Oil E can give production increases of at least 25% with comparable cost savings.

Incredible as this may seem, Dromus® Oil E alone accounts for these considerable production increases! And here's how simply Dromus E does it: Use Dromus Oil E (diluted with 20 parts water) at the correct cutting speed. Then, increase the feed rate by one-third and operate as before. You can get a 25% production increase . . . optimum conditions may show as high as 40% improvement!

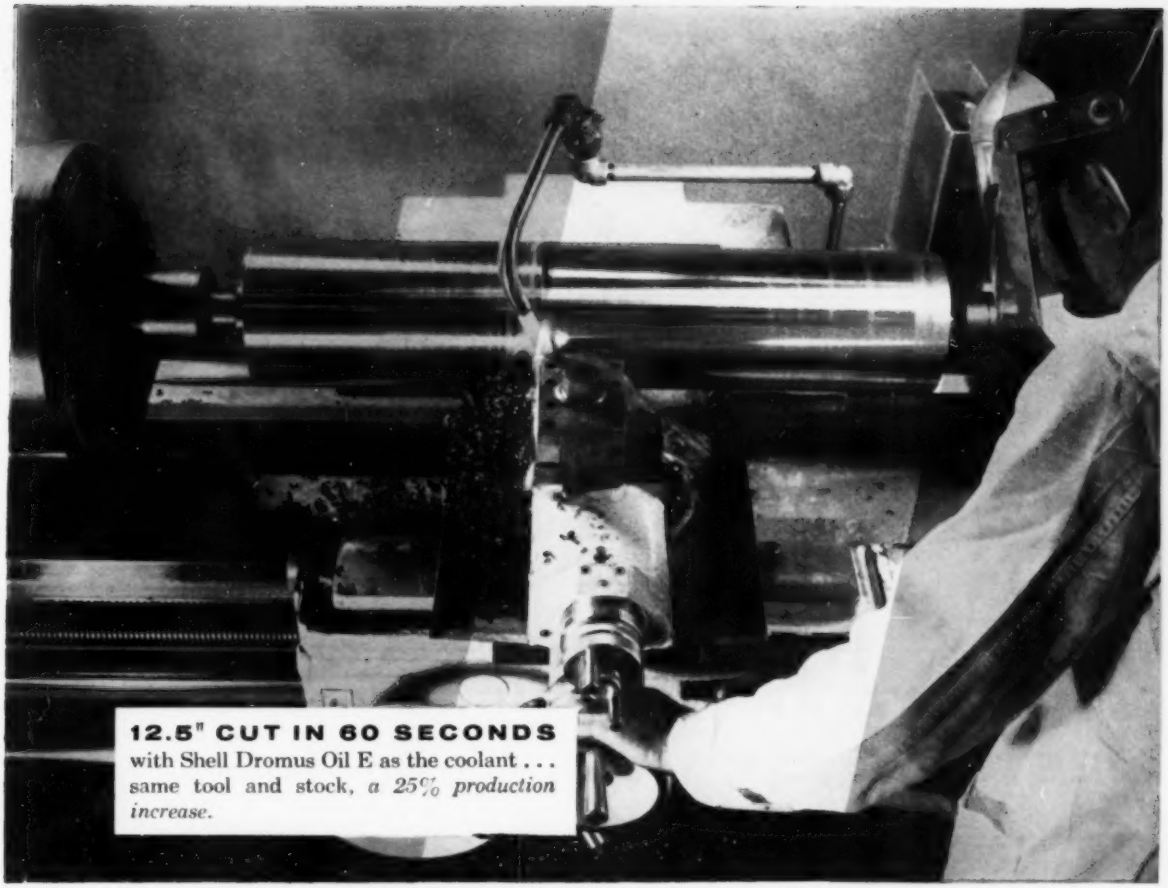
Applies to wet or dry cutting. Regardless of whether you're now cutting dry, or with emulsions or heavy-duty oils, this simple increase of feed applies.

Applies to all milling, turret and automatic lathe set-ups. This is an across-the-board production improvement. If the machine can stand the extra 25% feed, the rule applies to all milling and turning jobs!

Applies to set-ups as they are . . . no changes required. There isn't a single thing that has to be changed or adjusted . . . just the feed and provision for keeping the work wet with Dromus E.

Shell Dromus Oil E offers these many other outstanding benefits too!

1. Greater worker safety—chips are cool.
2. No fire hazard—Dromus E is nonflammable even after water evaporation.
3. Closer dimensional tolerances can be obtained—less heating of the work piece occurs.
4. Brighter surface finish is obtained.
5. Excellent protection against rust.



permits 25% greater feed
(AT FULL SURFACE SPEED)

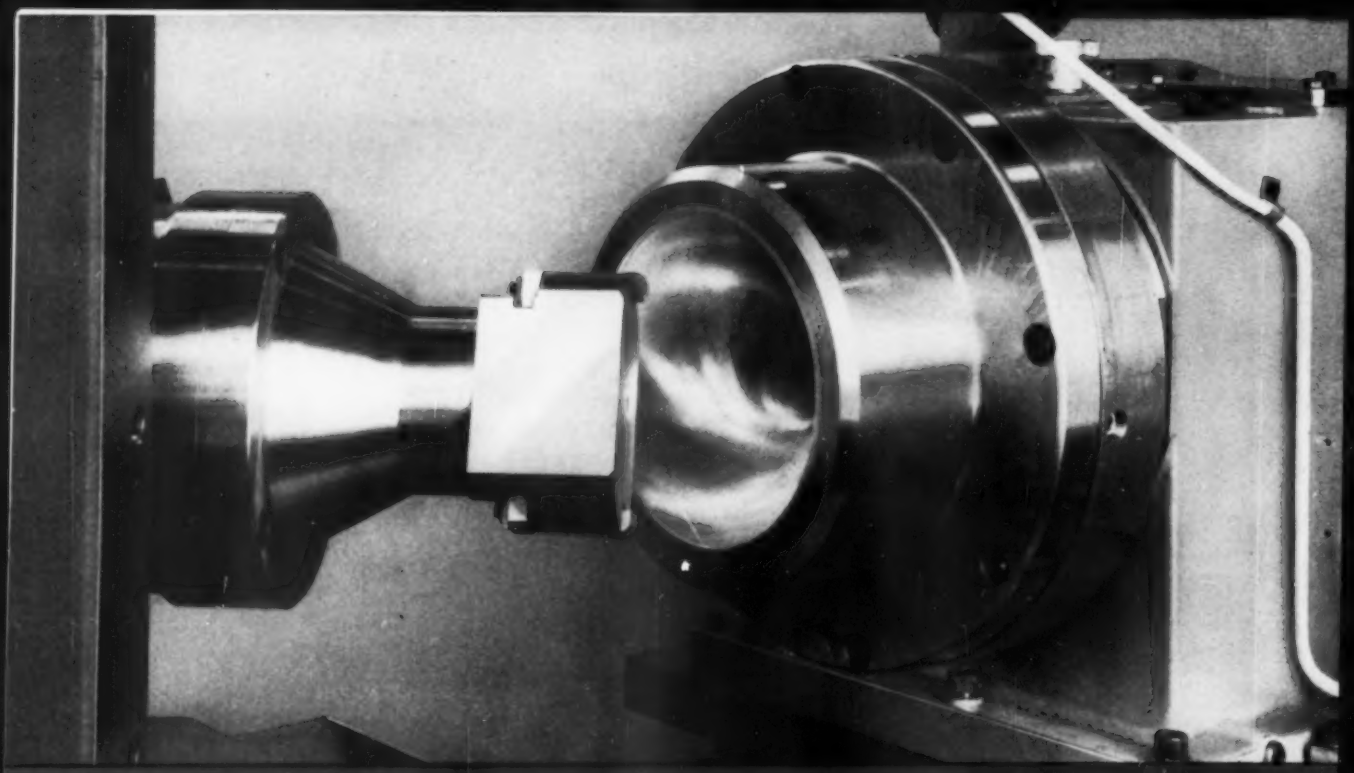
carbide "throw-away" insert

Dromus Oil E is one of those products that comes up once in a generation. Rather than attempt to offer proof after proof of what this announcement offers, we simply invite you to let the Shell Industrial Products Representative show you what Dromus Oil E can do in *your* plant! Please write Shell Oil Company, 50 West 50th Street, New York 20, New York, or 100 Bush Street, San Francisco 6, California. In Canada: Shell Oil Company of Canada, Limited, 505 University Avenue, Toronto 2, Ontario.

SHELL DROMUS OIL E

THE NEW COOLANT FOR METALWORKING

SHELL

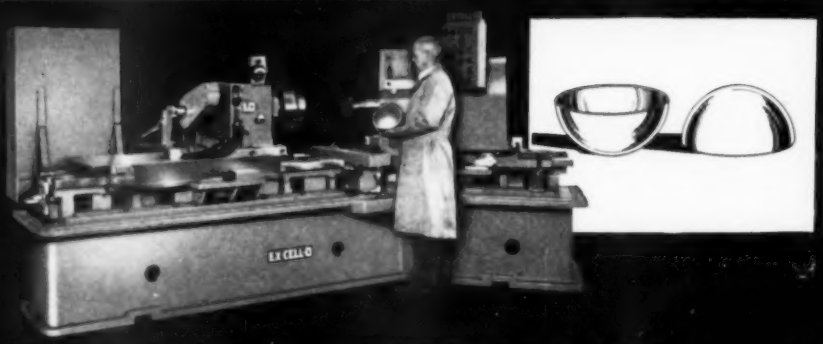


EX-CELL-O CUSTOM TURNING MACHINE MEETS DEMAND WITH PERFORMANCE

WORK: Rough and finish turning of I.D. and O.D. with automatic cycling between loads.

ACCURACY: Less than .0001" tolerance on radii and .0001" on total wall thickness. Surface finish to 10 rms.

MATERIAL: Wrought or forged annealed aluminum hemispheres, 6" to 16" dia.



Custom-equipped with gages, spindle tachometers and other features, hemisphere-turning machine is a job-tailored "special"—yet it is designed to accommodate future production changeover.

59-34

Here are just a few of the reasons why this special Ex-Cell-O Turning Machine meets demand with *precision performance*—every time:

An extremely accurate and rigid work spindle helps slim-down the hemispheres shown at a rate of 15 cu. in. per minute with a ⅛" cut. Separate variable-speed hydraulic motors give cutter speeds from 50 rpm to 2500 rpm, and work spindle speeds from 1/18 rpm to 4 rpm. Dial gages provide constant checks on work spindle slide and cutter plunge depth. Vacuum chucks hold the work securely, and full electrical interlocking protects operator and machine during production.

Perhaps a similar Ex-Cell-O special machine—designed to handle future work as well—is the answer to a production problem in your operation. Call your Ex-Cell-O Representative, or write direct for full details.

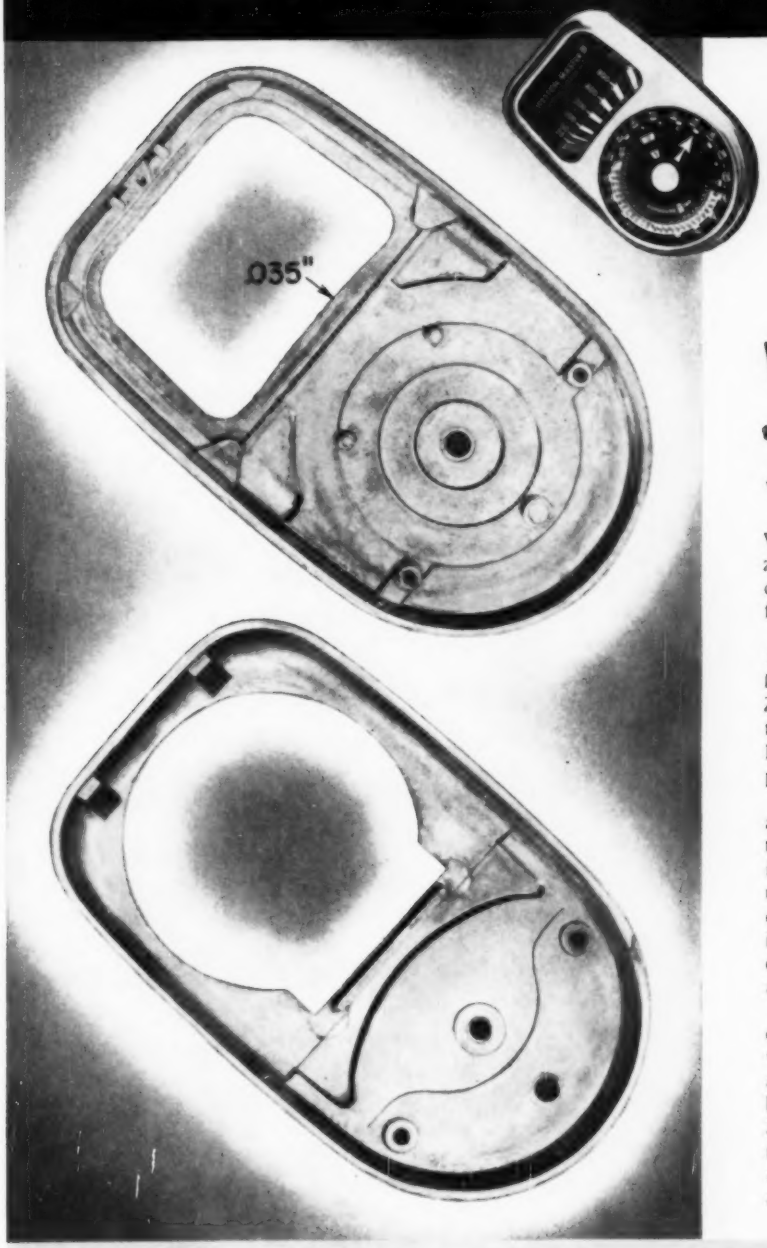
PRECISION FOR EX-CELL-O (XLO)

EX-CELL-O CORPORATION *Machinery Division*

DETROIT 32, MICHIGAN

EX-CELL-O PRECISION PRODUCTS INCLUDE: MACHINE TOOLS • GRINDING AND BORING SPINDLES • CUTTING TOOLS • RAILROAD PINS AND BUSHINGS • DRILL JIG BUSHINGS • TORQUE ACTUATORS • THREAD AND GROOVE GAGES • GRANITE SURFACE PLATES • AIRCRAFT AND MISCELLANEOUS PRODUCTION PARTS • DAIRY EQUIPMENT

IT'S LIGHTER THAN YOU THINK!



EXCEPTIONALLY ACCURATE... STRONG... ECONOMICAL... WHEN DIE CAST with ZAMAK

WESTON has been using these wafer-thin zinc die castings for the front and back covers of this world-famous exposure meter for 14 years.

Converting from an all-plastic case in 1945, Weston selected zinc die casting alloys for this popular precision instrument because ZAMAK offered the most in all-'round advantages. High strength combined with the lightness of a thin-wall zinc die casting were primary considerations.

Extreme accuracy of dimensions, as-cast, and the convenience of casting contours on the inside of the case for mounting to the instrument were additionally important values. Ease of assembly of the tamper-proof construction and a lasting, satin-chrome finish were extra dividends – all of these and economy, too, when die cast with ZAMAK alloys.

As in many other applications, such extremely thin wall sections – possible only with zinc die castings – minimize weight and are stronger **in proportion to thickness** than heavier sections. Such parts designed for ZAMAK alloy die casting will more than meet competition of either stampings or aluminum castings – provide many more advantages and all at lower cost.

HORSE HEAD® SPECIAL ZINC AND HORSE HEAD ZAMAK ARE PRODUCED BY

THE NEW JERSEY ZINC COMPANY

DEVELOPERS OF THE ONLY STANDARD ZINC DIE CASTING ALLOYS IN USE TODAY

160 Front Street · New York 38, N. Y.

HORSE HEAD PRODUCTS ®

Cuts inventory, yet widens range of "custom" machining

GULF MAKES THINGS

How do you maintain "custom" standards of machining, and yet hold down operating costs in the face of a constantly expanding diversity of projects?

That was the problem faced by the Rolling Mill Division of E. W. Bliss Company, Salem, Ohio. This division produces a wide variety of metal processing equipment, from machine tools of bench-top size to multi-million dollar rolling mill installations.

H. G. Gibson, Plant Engineer of the Rolling Mill Division, found the answer in just three of the multi-purpose cutting oils in the Gulfcut line. Gulfcut 21A, Gulfcut 31A and Gulfcut Soluble Oil proved effective over the complete range of tough machining jobs at the plant, and permitted a wholesale reduction in oil inventory.

"Our alternative," reports Mr. Gibson, "would be a stockpile of individual cutting oils and special additives for individual jobs—with a resulting step-up in inventory costs. But these 3 Gulfcut oils meet *all* our machining requirements.

"In high-precision gear hobbing, for example, Gulfcut 21A—a sulfurized-mineral oil—dissipates the extreme heat rapidly and thus checks expansion of both hob and workpiece. Helps us hold tolerances within .001" in this operation.

"In the boring, facing and turning of large gear rings, Gulfcut Soluble Oil gives us the critical cooling required

Gulf man on the job checks precision-hobbed gears at Rolling Mill Division of E. W. Bliss, where Gulf helps make things run better. Left, Fred Sweitzer, General Superintendent. Right, William A. Stranko, Gulf Sales Representative.

Hobbing helical gears for rolling mill tables, on a 72" gear hobber, at Rolling Mill Division of E. W. Bliss Company. Hob is flooded with Gulfcut 21A, which helps achieve rough hobbing of .625" and finish hobbing of .090" on steel of 280-311 Brinell hardness. Pinion is cut at 7½° helix angle in the illustration at left.

with 3 multi-purpose Gulfcut oils . . .

RUN BETTER!

and permits a feed of 325 sfpm with no loss in tool life.

"In a tough screw-cutting operation, where the piece is 25 feet long, Gulfcut 31A—a sulfurized-mineral-lard oil—helps us achieve the specified 16 micro-inch rms finish on highly polished screws used in steel mill roll changing units.

"In hundreds of other jobs, these 3 multi-purpose Gulfcut oils help us maintain our high machining standards on a low oil inventory."

Your plant can cut machining costs and upgrade production with Gulfcut oils. There's a grade for every need in the complete Gulfcut line. Call your nearest Gulf office or mail coupon for illustrated bulletins.

GULF

GULF OIL CORPORATION
Dept. DM, Gulf Bldg., Pittsburgh 30, Pa.

Send me illustrated bulletin on

- ☐ Gulfcut "regular" oils.
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City _____ Zone ____ State _____

SP 9604

Introducing the NEW MODEL 1-A SEVER-ALL Machine... CUTS AT 3 to 6 SECONDS PER SQUARE INCH—ECONOMICALLY

MANY EXTRA FEATURES AT A DELIVERED COST UNDER $500

You get the cut quality and capacity of machines nearly three times as expensive when you use the new Model 1-A SEVER-ALL oscillating dry abrasive cut-off machine. Available from your distributor's stock. Here's why the 1-A SEVER-ALL is ideal for industrial and machine shop operations:

BIG CAPACITY • Up to 2" square solids, 3½" O. D. pipe and tubing, 3" angle iron, and 4" channels . . . of cold rolled, stainless, and alloyed steel; cast iron; and nonferrous metals. Wheel oscillation, an exclusive feature in this price range, provides this *above-average* capacity.

SPEED • Cuts a 2" x 2" hardened steel bar in 16 seconds . . . other shapes and sizes at 3 to 6 seconds per square inch.

QUALITY • Clean, smooth cuts, even on large sections, because wheel oscillation provides cooler cutting.

ECONOMY • In addition to low initial cost, the Model 1-A SEVER-ALL is inexpensive to operate . . . occupies minimum floor space . . . requires little or no set-up time . . . eliminates annealing costs . . . gives more cuts per wheel because of oscillation.

SIMPLICITY • Just two SEVER-ALL cutting wheel specifications will do *all* your SEVER-ALL cutting jobs. A positive, screw-type vise holds all regular shapes, and an adjustable work stop provides speed and accuracy.

ANGLE CUTS • Optional accessory permits cutting angles up to 45° in either direction.

NEW SEVER-ALL AVAILABLE FROM DISTRIBUTORS

Very likely your own distributor already stocks the Model 1-A SEVER-ALL machine and wheels. If not, let us know, and we'll give you the name of your nearest SEVER-ALL distributor. Also, we'll be glad to send you complete details on this new machine. Just ask for **Bulletin DH-106.**

ALLISON-CAMPBELL DIVISION
AMERICAN CHAIN & CABLE

ACCO

923 Connecticut Avenue, Bridgeport 2, Conn.

◀ CIRCLE 202 READER SERVICE CARD

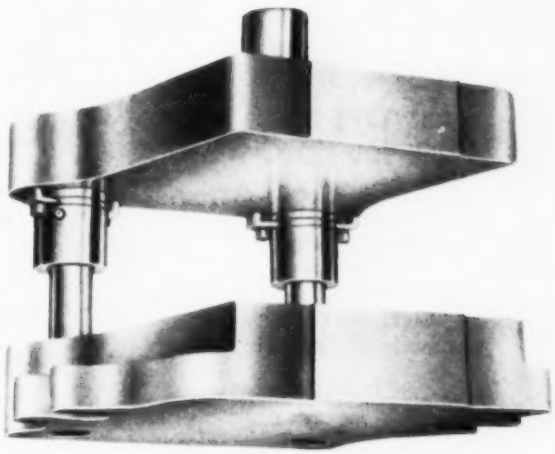
▲ CIRCLE 203 READER SERVICE CARD

DANLY®

The Newest Products for the Stamping Industry

in **PRESSES**

in **DIE SETS**
and Die Makers' Supplies



ready for immediate delivery

From stock

Danly's Open Back Inclinable Presses bring big press efficiency to the small press field.

Each O.B.I. Press – capacities from 25 to 200 tons – is equipped with the exclusive Danly Air Clutch and Brake. This Clutch gives these presses all the reliability and flexibility of operation of the Danly Straight Side, Underdrive and Autofeed Presses. The clutch of "low inertia" design wears less because of low weight load picked up on each engagement. It runs cooler and costs less to maintain.

The ruggedness of heavy welded steel frame construction engineered into all Danly Presses, features this new O.B.I. line. The rugged construction throughout minimizes vibration, deflection and breakage. In combination with Danly Air Friction Clutch it assures long press life–continuity of production–accurate stampings–low cost of production and maintenance. This new line is priced for economy.

Stocked and assembled in 20 tool-making centers

Now all Danly Precision and Commercial Die Sets are assembled with demountable bushings and press-fit guide posts–to provide the most accurate die sets on the market. Chance of distortion is minimized. Posts and bushings are pre-fitted to dimensions, within tolerance, at the factory and furnished as matched units in all die sets. Pre-fitting is so accurate that bushings and guide posts are completely interchangeable.

To this new precision, Danly also adds unequalled availability made feasible by this new method of assembly. These die sets are stocked for prompt assembly and delivery by 20 factory branches and distributor assembly plants throughout the country. Your local Danly outlet is your source for die sets and toolroom and pressroom supplies that bear the stamp of leadership.

WRITE DANLY TODAY

Write us and your distributor or branch will place the money-saving facts about these newest Danly products before you.

DANLY MACHINE SPECIALTIES, INC.

The Leading Supplier

DANLY®

2100 S. Laramie Avenue, Chicago 50, Illinois

to the Stamping Industry

For complete chain drives ¼" to 2" pitch . . .

BOSTON Gear SPROCKETS and CHAIN

FROM STOCK . . . at Factory Prices

Catalog No. 57 lists

ANY TYPE OR SIZE YOU NEED

.81" to 50.94" P.D. **SPROCKETS,** iron and steel, for single ROLLER CHAIN

1.92" to 26.74" P.D. **SPROCKETS,** iron and steel, for double ROLLER CHAIN

¼" to 2½" P. **ROLLER CHAIN** single, double, and triple strand

DOUBLE PITCH ROLLER CHAIN
1", 1¼", 1½" P. Drive Series
1", 1¼", 1½", 2" P. Conveyor Series
1", 1¼", 1½", P. Agricultural Series

1.94" to 12.74" P.D. **SPROCKETS,** iron and steel, for BLOCK CHAIN
⅛" to ½" w. **BLOCK CHAIN**

.37" to 6.07" P.D. **SPROCKETS,** bronze and steel, for LADDER CHAIN
.185" to .353" P. **LADDER CHAIN** brass and steel

Save machining time

SHOLD-A-GRIP
interchangeable tapered **SPROCKETS and BUSHINGS**
2.09" to 23.88" P.D. SPROCKETS adaptable with tapered BUSHINGS to shaft sizes ½" to 3" by 16ths

BORED-TO-SIZE
ready-to-install **SPROCKET PINIONS**
Complete with keyway and setscrew. ⅜" through 1" P., in 86 tooth sizes, with 360 stock bores

Order from your local Distributor. You save time and expense — you get BOSTON Gear top-rated quality and lasting economy. Be cost-wise — standardize. Boston Gear Works, 60 Hayward St., Quincy 71, Mass.

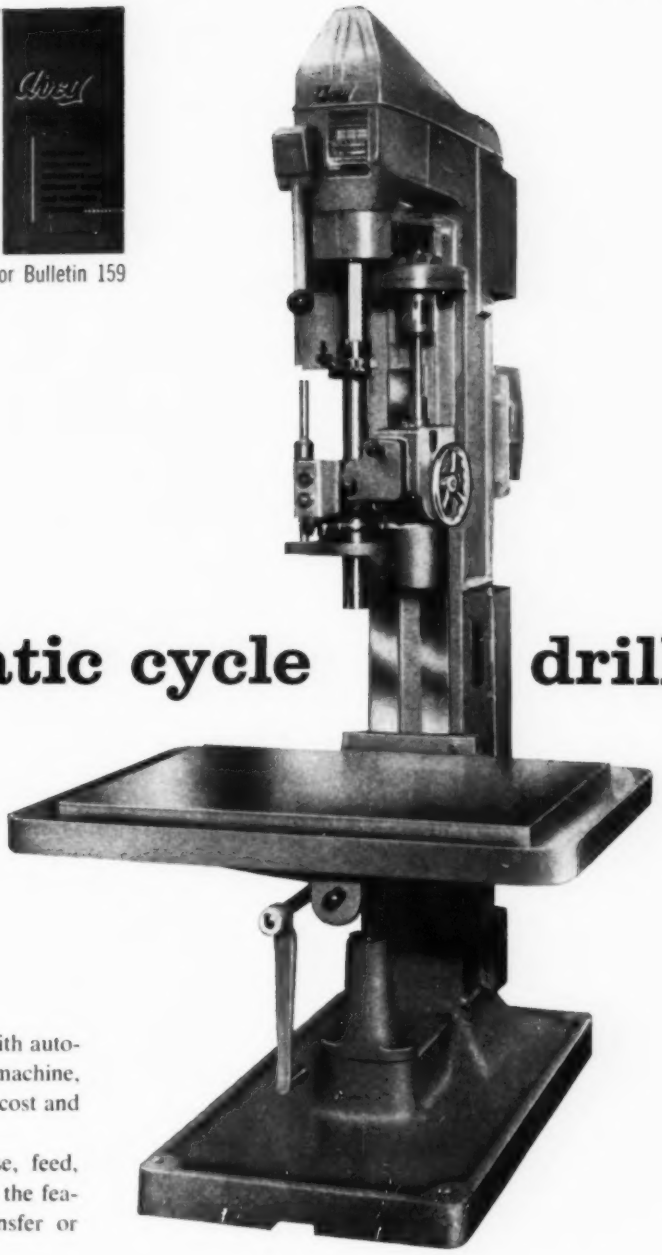
CALL YOUR NEARBY

BOSTON Gear DISTRIBUTOR

— STANDARDIZATION PAYS —

9496 "OFF-THE-SHELF" TRANSMISSION PRODUCTS **FROM STOCK** — AT FACTORY PRICES — ASK FOR CATALOG
Stock Gears • Sprockets and Chain • Speed Reducers • Bearings • Pillow Blocks • Couplings

Write for Bulletin 159



automatic cycle drilling

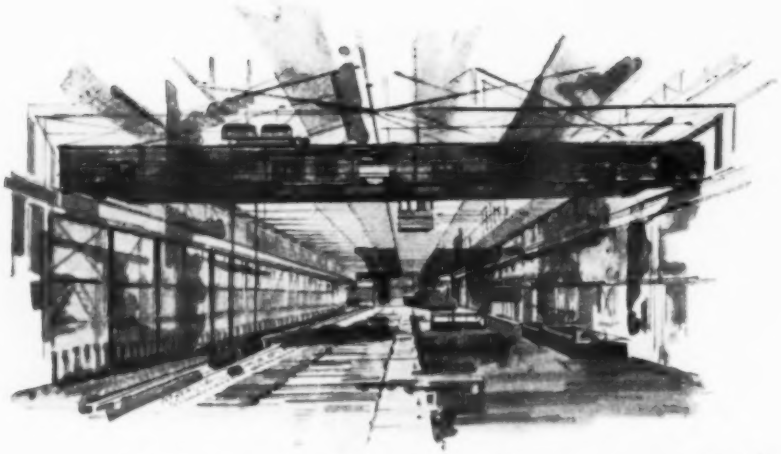
■ You can chop your time costs with automatic set-ups on this new Avey machine, and still take advantage of the low cost and flexibility of a standard unit.

Adjustable rapid power traverse, feed, and rapid return of the spindle are the features which permit automatic transfer or rotary index fixturing.

At the same time, you get adjustable feeds, speeds, table travel, head travel, and Avey's advanced spindle construction.

The machine is available with No. 2, 3, and 4 Morse Taper; 1 to 3 HP motors; single or multiple spindles. Your request for additional information will be promptly answered. Avey Division, The Motch & Merryweather Machinery Co., P. O. Box 1264, Cincinnati 1, Ohio.

Avey



At one of the world's largest integrated steel companies, over 1400 Farval systems unfailingly deliver proper lubrication to each vital bearing on 700 overhead traveling cranes. When equipment is Farvalized . . . maintenance is kept at a minimum.

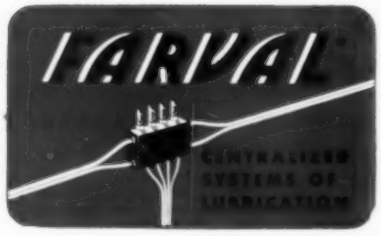
Get the complete story from your local Farval representative.

Or write today for your free copy of Bulletin 26-S. It gives a complete rundown on Farval equipment and how it can help improve your plant operations.

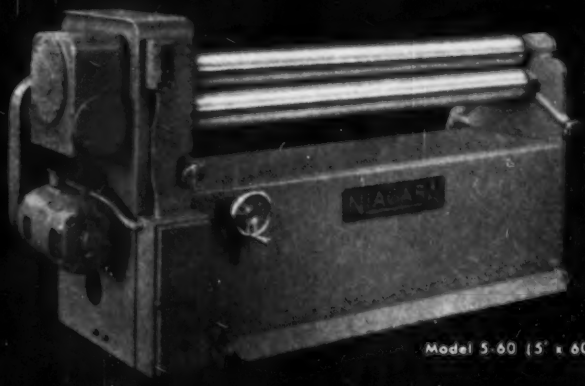
Farval-Studies in Centralized Lubrication No. 241

The Farval Corporation, 3254 East 80th Street, Cleveland 4, Ohio
®Reg. U. S. Pat. Off.

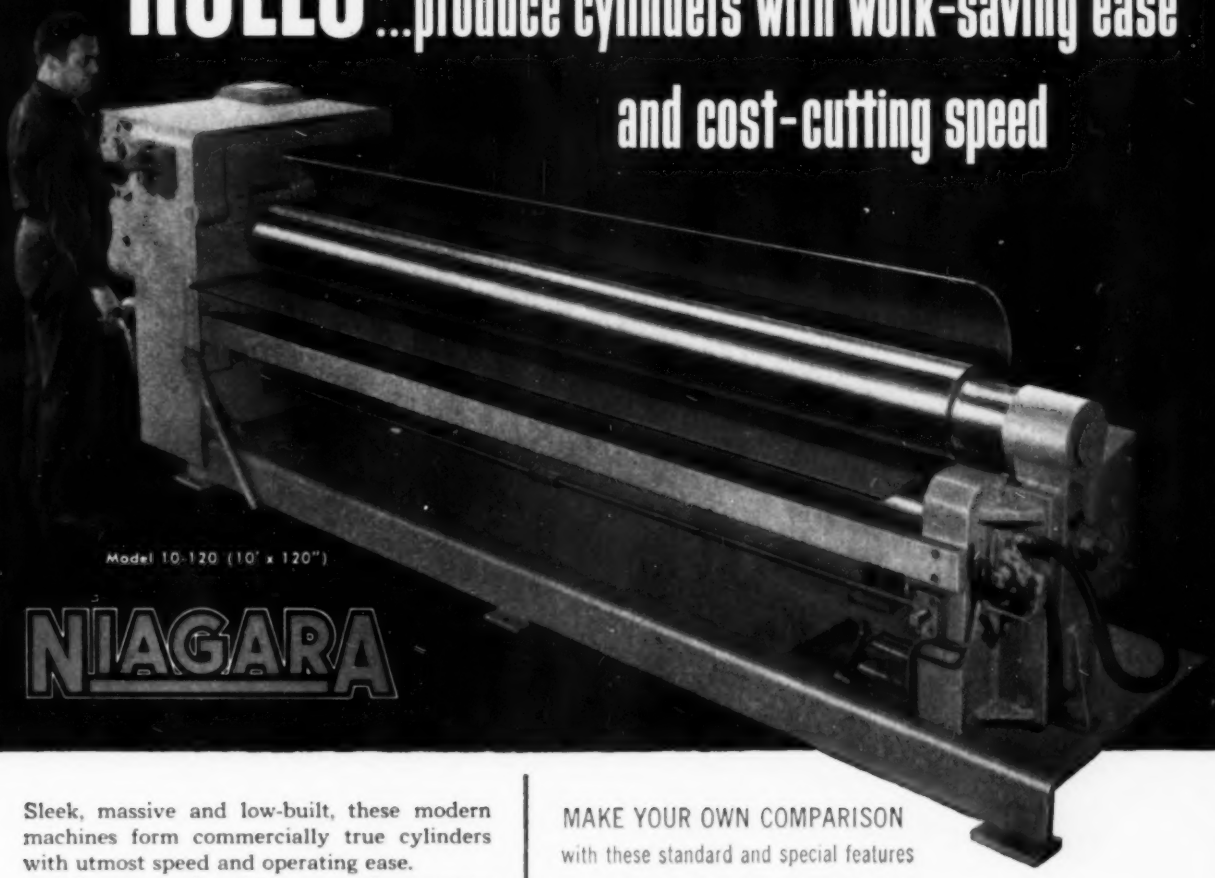
Affiliate of The Cleveland Worm & Gear Company
A subsidiary of Eaton Manufacturing Company



NEW 5"-10" BENDING ROLLS ...produce cylinders with work-saving ease and cost-cutting speed



Model 5-60 (5' x 60")


Model 10-120 (10' x 120")

NIAGARA

Sleek, massive and low-built, these modern machines form commercially true cylinders with utmost speed and operating ease.

Adjustments for thickness and curvature are made quickly. A three-roll gear train keeps gears continually in mesh. Curving starts easily. Work in the rolls can be stopped instantly, reversed rapidly, or jogged in short increments . . . *at the touch of a button.* No drifting! Operation is quiet: Silent worm gear drive runs in a sealed bath of oil. Fully formed cylinders are easily removed via an air operated drop end. Performance is vibration-free: No foundations or floor bolting necessary.

Built in 5, 6, 7, 8, 9 or 10 in. diameters, Niagara Bending Rolls handle materials up to 14 ft. long and ⅞ in. thick. For complete information, request Bulletin 77.

MAKE YOUR OWN COMPARISON

with these standard and special features

- Silent, totally enclosed worm gear drive
- Rugged, all-welded steel construction
- Full length, emergency stop treadle
- Three-roll gear train speeds work, protects quality
- Air operated drop end for easy removal of cylinders
- Quick, lower pinch roll adjustment
- Rear roll power adjusted, with indicators to duplicate settings
- Pinch type rolls minimize flat spots
- Longitudinal grooves permit one-pass forming of small diameters
- Pushbutton controls, conveniently located at operator's station
- High torque main drive motor with magnetic brake and reversing control
- Centralized pressure lubrication

NIAGARA MACHINE & TOOL WORKS • BUFFALO 11, N.Y. • District Offices and Distributors in principal U.S. cities and major foreign countries

▲ CIRCLE 208 READER SERVICE CARD

CIRCLE 209 READER SERVICE CARD ►

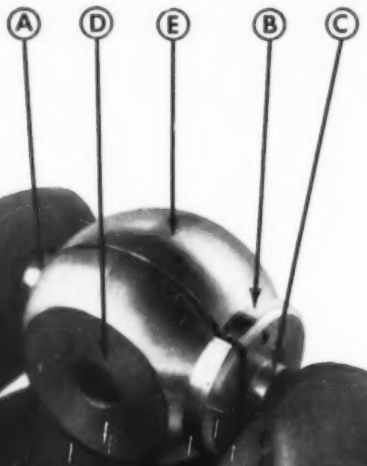
For productiveness in the toolroom

MONARCH YEARS-AHEAD

Versatile as they come

The same basic machine is offered in two standard forms—with screw-cutting equipment as a Toolroom Lathe—without screw-cutting features, as a Manufacturing Lathe. Such additional items as the following improve productivity and enhance versatility.

Air-Gage Tracer
Automatic Cycling
Hydraulic Turret
Steady Rest
Follow Rest
Taper Turning Attachment
Collet Attachments
Air Equipment
Bar Feed Attachment



PRECISION PERFORMANCE

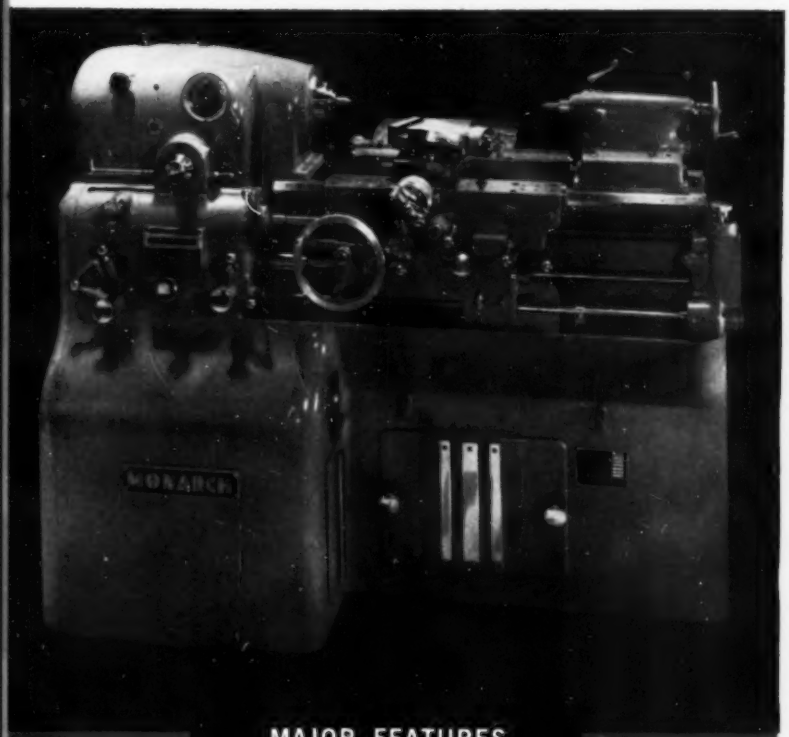
Here's a beautiful example of turning as both a science and an art. Just consider typical tolerances on this miniature gyro gimbal housing:

1. *Diameters A, B, C, E on same center line within .0002" T.I.R. and square to bore D within .0005" T.I.R.*
2. *All outside diameters concentric with inside diameters within .001" T.I.R.*
3. *Wall thickness E .030" ± .001"*
4. *Diameter A +.0002"; —.000"*
5. *Diameter C +.0005"; —.000"*

These units are externally and internally tracer turned to the above tolerances by Vee-Arc Corporation of Westboro, Massachusetts. Air-Gage Tracer equipped Monarch 10" EE Lathes are used—in conjunction with Vee-Arc Super-Precision Live Centers which are accurate within .000020" T.I.R.

for toolroom accuracy in production!

10" MODEL EE PRECISION LATHES



with many refinements PLUS 2 more horses

Any Model EE user will tell you it has long been the lathe of tomorrow. Now it's an even better machine with more power, more convenience, more productiveness.

For precision turning, boring, facing and threading in the toolroom this lathe has no equal. It's fully as proficient for such super-accurate manufacturing operations as required for small jet, missile, instrument, electronic and camera components.

Check the listing of major features; take a look at the job report and the many typical parts turned on this machine. Then, put it up to us to show you how the 10" EE can solve many of your turning problems with EEse.

THE MONARCH MACHINE TOOL COMPANY,
Sidney, Ohio.

If it can be turned
there's a Monarch to do it
better and faster

MAJOR FEATURES

- *5 H.P.* drive direct to spindle through multiple "V" belts, providing an infinitely variable speed range. No gears in the headstock.
- Standard speed range, 5 to 3000 R.P.M.; optional range, 6.5 to 4000 R.P.M.
- D.C. variable speed motor secures its power through an electronic unit which utilizes almost any source of A.C. This type of power supply minimizes vibration at all speeds, practically eliminates noise, improves speed regulation regardless of load and maintains better torque at the lower speeds.
- Spindle comes to dead stop in less than 2 seconds, attains full speed in less than 3 seconds.
- Automatic lubrication throughout.
- American standard Camlock spindle nose—for quick, rigid and accurate chuck and fixture mounting.
- Wide range of threads and feeds through totally enclosed gear box and end gearing.
- Cross feed and leadscrews induction hardened and ground.
- Flame hardened and precision ground bed ways for both carriage and tailstock. Bed all in one piece—no inserts.
- Easy, fatigue-free operation. Base design permits operator to work close comfortably, from standing or sitting positions.
- The only small lathe available with anti-friction bearing taper attachment.
- For thread chasing up to 100% faster, is available with exclusive combination of electric leadscrew reverse and variable reverse speed control.

Monarch
TURNING MACHINES

30% TO 50% LONGER LIFE FOR RESINOID-BONDED DIAMOND WHEELS

Six hundred separate trials, using 145 wheels, were run by the Diamond Research Laboratory to test a completely new type of natural diamond grit for resinoid wheels. The results: this new grit increases the life of natural diamond resinoid-bonded wheels by 30% to 50%.

The particles of this new grit do not readily pull out of the bond. Instead, they break down into ever-finer fragments which constantly expose new, sharp cutting surfaces.

TEST EQUIPMENT: Three 18" Jones & Shipman production grinders were fitted with special spindles to enable wheels to operate at 5500 surface feet per minute, the speed generally used in diamond grinding.

The wheels were of the D1A1 type, 6" in diameter, 3/16" face width, with 1/8" depth of resin. Each wheel contained 31 1/4 carats of the new grit. Metal to be ground was tungsten carbide of the same quality normally used for milling cutters, lathe tools, etc. During the course of the tests, 700 pounds of hardest carbide were ground away.

RESULTS: This new friable grit, Selected Natural Diamond (SND-RESINOID), increases the life of natural diamond resinoid wheels by 30% to 50%, depending on the type of job at hand. The grit will be available to your wheel manufacturer soon. Next time you order diamond resinoid wheels, specify SND-RESINOID . . . the most economical *and* the most efficient grit you can use.

◄ CIRCLE 210 READER SERVICE CARD

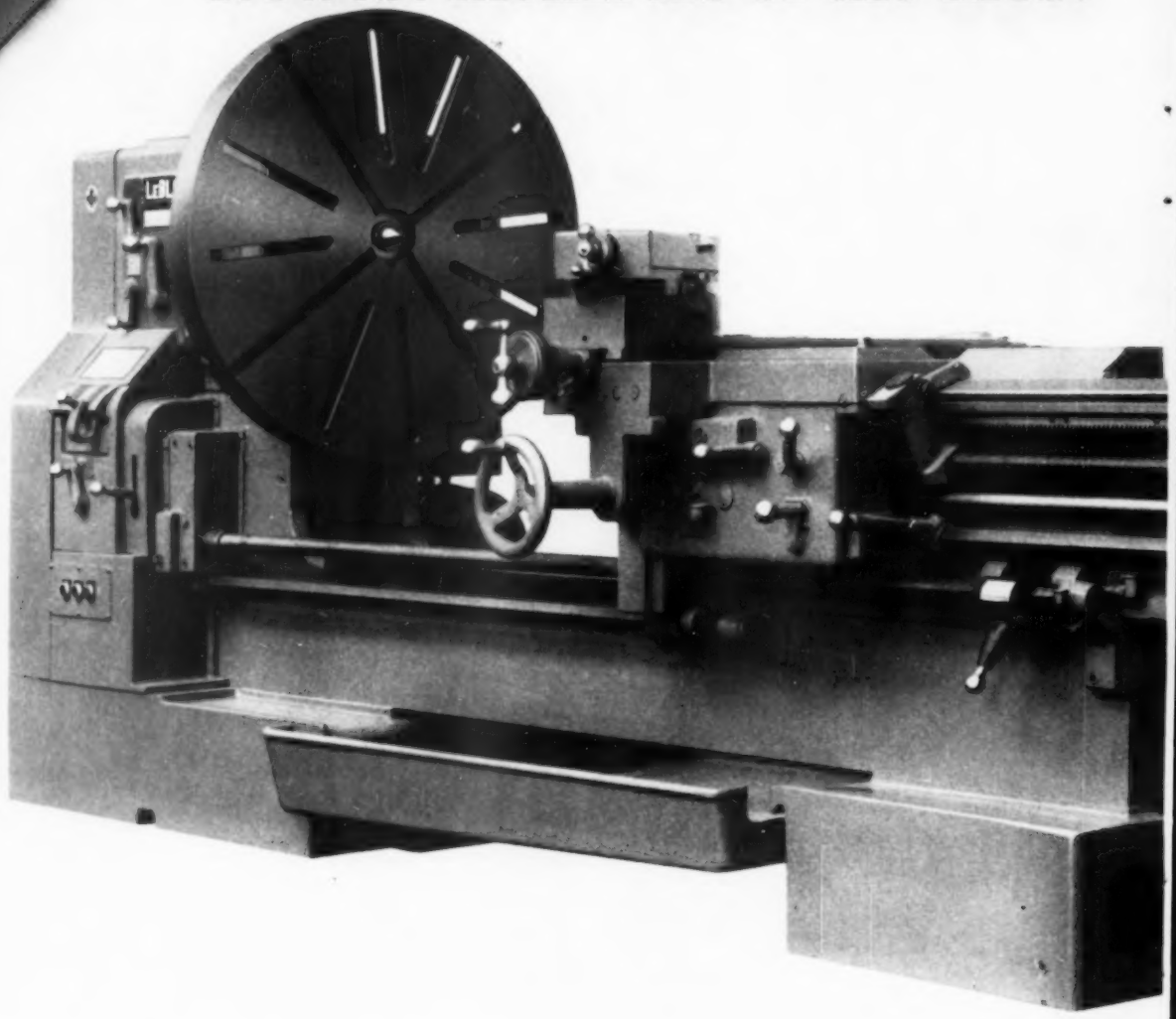
▲ CIRCLE 211 READER SERVICE CARD

Tests were run on these three Jones & Shipman production grinders. Results showed that the new grit, Selected Natural Diamond (SND-RESINOID), increases the life span of natural diamond resinoid wheels by 30% to 50%.

INDUSTRIAL DISTRIBUTORS (SALES), LTD.

YOU CAN DEPEND ON NATURAL DIAMONDS

Newest members of the most



	REGALS		NEW!		HEAVY DUTIES		
	17"/28"	19"/28"	21"/39"	24"/39"	16"/38"	25"/50"	32"/60"
Swing over bed and carriage wings	17¾"	19¼"	22¼"	26"	20½"	30½"	34½"
Swing over gap	35"	36½"	48½"	52½"	46"	56"	61½"
Distance between centers, base, gap closed	30"	30"	48"	48"	72"	96"	84"
Distance between centers, base, gap open	50"	50"	84"	84"	120"	156"	144"
Horsepower, max.	5	5	10	10	20	50	60

Hollow Spindle Head available on all but 17" and 19" models.

versatile family in the world

21" and 24"/39" Regal

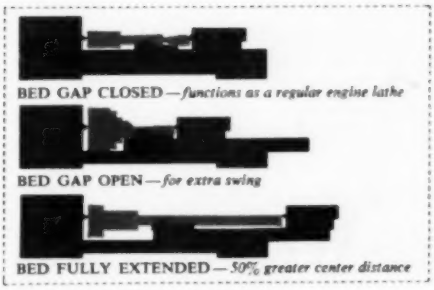
SLIDING BED GAP LATHES

Turning department in one machine!

The LeBlond Sliding Bed Gap Lathe is the most versatile turning machine ever built. With the bed closed it functions as a regular engine lathe. Its special bed *slides* open to form a gap of the proper opening to accept odd-shaped parts and large diameter jobs. Sliding the bed open also provides greater distance between centers. In addition, you get all the outstanding features, the stamina and dependability you expect in a LeBlond Lathe.

The two new members bring the family up to seven! Select the one that suits you best from the chart at left.

Call your LeBlond Distributor or write-



BED GAP CLOSED—*functions as a regular engine lathe*

BED GAP OPEN—*for extra swing*

BED FULLY EXTENDED—*50% greater center distance*

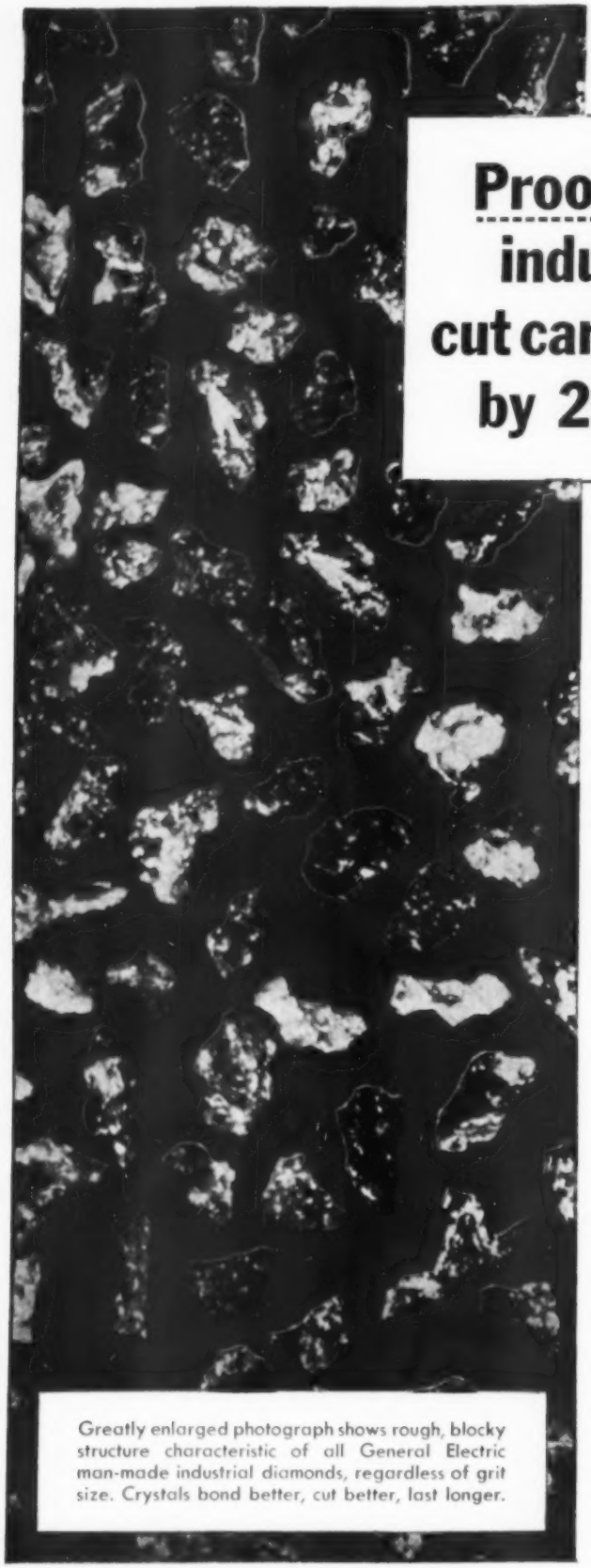
Here's how a LeBlond Sliding Bed Gap Lathe gives you extra capacity, versatility:

LeBLOND of Cincinnati

THE R. K. LeBLOND
MACHINE TOOL COMPANY
CINCINNATI, OHIO

Metallurgical Memo from General Electric

Proof! G-E man-made industrial diamonds cut carbide grinding costs by 25%-35% average



Greatly enlarged photograph shows rough, blocky structure characteristic of all General Electric man-made industrial diamonds, regardless of grit size. Crystals bond better, cut better, last longer.

Diamond wheel users report on significant savings in switch from natural to man-made diamond wheels Here are some examples:

Automotive Manufacturer, cutter grinding: 5″ x $1\frac{3}{4}$″ x $1\frac{1}{4}$″ flaring cup wheels, resinoid bond, 100 concentration, 100 grit—dry grinding. Man-made diamond wheel produced 1217 cutters and still had one-third of the wheel left. Natural diamond wheel produced only 696 cutters per wheel.

Power Tool Company, carbide burr grinding: 6″ x $\frac{1}{8}$″ x $1\frac{1}{4}$″ straight wheels, resinoid bond, 100 concentration, 180 grit—dry grinding. Wheel life with G-E man-made diamonds was 48 hours, while that of the natural diamond wheel was only 34 hours.

Saw Manufacturer, sharpening carbide knives and saws: $3\frac{3}{4}$″ x $1\frac{1}{2}$″ x $1\frac{1}{4}$″ flaring cup wheels, resinoid bond, 100 concentration, 120 grit—wet grinding with Cincinnati tool and cutter grinder. Man-made diamond wheel removed 70% more carbide with 57% less wheel wear.

Laminated Die Manufacturer, internal grinding of carbide dies: $1\frac{1}{2}$″ x $\frac{1}{4}$″ x $\frac{1}{4}$″ straight wheels, resinoid bond, 100 concentration, 320 grit. Wheel with General Electric man-made diamonds cut faster with longer life than natural diamond wheel.

General Electric man-made industrial diamonds can make savings like those above possible in *your* plant. Specify them from your wheel manufacturers. *Metallurgical Products Department of General Electric Company, 11149 E. 8 Mile Blvd., Detroit 32, Mich.*

METALLURGICAL PRODUCTS DEPARTMENT

GENERAL ELECTRIC

CARBOLOY® CEMENTED CARBIDES
MAN-MADE DIAMONDS • VACUUM-MELTED ALLOYS
THERMISTORS • MAGNETIC MATERIALS • THYRITE®

NEW from DELTA

20" metal-wood *variable speed* BAND SAW

No matter what your cutting requirements —in the foundry, toolroom or pattern shop —this all-new Delta 20" Metal-Wood Band Saw gives you real on-the-job performance. Now—*for less than $900.00*—you can have the features you said you wanted most for greater accuracy and better cutting:

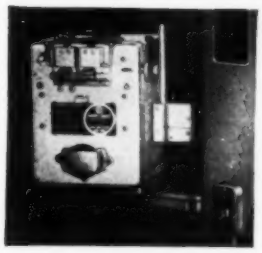
WIDE RANGE VARIABLE SPEED DRIVE ... gives you a tremendous speed range—50 to 4500 FPM—for cutting everything from stainless steel to aluminum, wood and plastics. This versatility can't be equalled.

SCIENTIFICALLY DESIGNED BLADE GUIDES ... ideal for heavy metal cutting because they furnish more "close up" blade support than conventional type guides. These new Delta blade guides are the key to better accuracy, straighter cuts, and longer blade life.

RUGGED FRAME CONSTRUCTION ... features a massive, rigid internal frame with a modern fabricated exterior. Exclusive 3-point adjustability (wheels, upper guide and table) assures perfect alignment of key components.

In addition to these outstanding features you get a massive table with double trunnion supports, convenient speed controls, plus built in chip blower *at no extra cost.*

SEE IT AT YOUR NEAREST DELTA DEALER—he's listed under "TOOLS" in the Yellow Pages or write: Rockwell Manufacturing Company, Delta Power Tool Division, 618J N. Lexington Avenue, Pittsburgh 8, Pa.



BLADE WELDER, including shear and grinder, shown on No. 28-462. Bracket mounted on 20" Band Saw for machine-side use. (Optional accessories)

DELTA INDUSTRIAL TOOLS

another fine product by

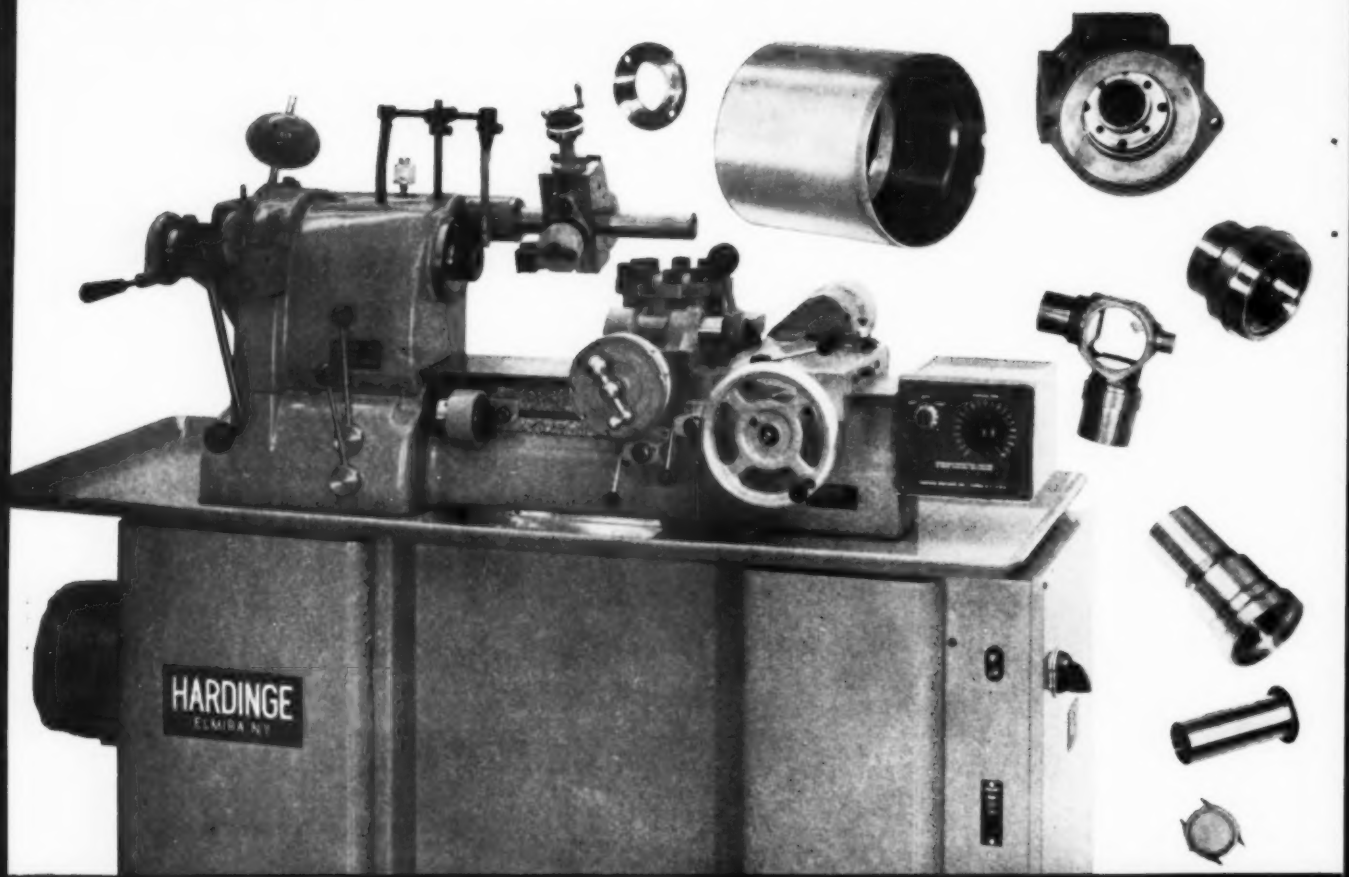
ROCKWELL

HARDINGE
ELMIRA, N.Y.

PRECISION CHUCKING MACHINE

Users say:

"We now get Production with Tool Room Accuracy"



Users enthusiastically tell us how they can easily maintain close tolerances, get better parts finish, and at the same time substantially cut costs . . . when they put Hardinge High Speed Precision Chucking Machines to work.

These results are possible because parts are finished in one setting with simplified tooling. All parts shown were produced with standard tool bits.

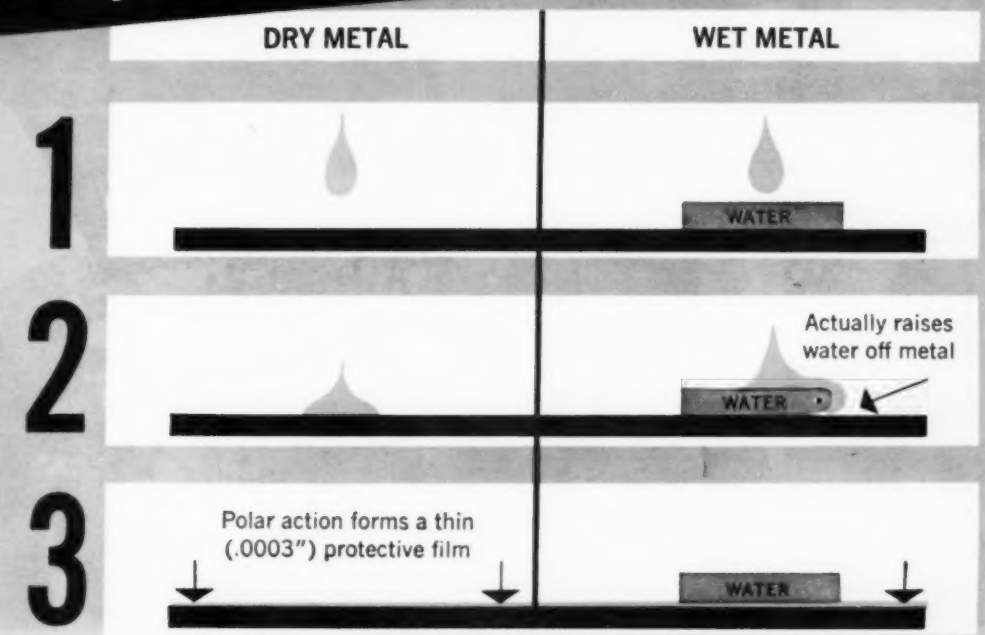
1 1/16" Collet Capacity— 6" Chucking Capacity— Write today for Bulletin HC-HCT which presents the whole story.

Offices in Principal Cities
Export Office: 269 Lafayette St., New York 12, New York

HARDINGE BROTHERS, INC., ELMIRA, N. Y.

PERFORMANCE HAS ESTABLISHED LEADERSHIP FOR HARDINGE

How *polarized* RUST VETO 377 protects metal... DRY or WET



If metal parts are wet, polarized Rust Veto 377 actually raises water off metal to form a long-lasting protective film under the moisture.

Now, metals don't have to be dry to be protected against corrosion by a fast, economical coat of multi-purpose Rust Veto 377 . . . your best long-term protection for tools, dies, bearings, machines and parts stored indoors or packaged. Its tough, thin .0003" film is practically invisible.

Rust Veto 377 literally displaces moisture and clings to the metal. It resists oxidation with no deterioration of the protective film for as long as a year. It can be used effectively, without staining, on all types of metal and you don't have to remove it except when parts are to be painted or plated.

For full details about Rust Veto 377 send for NEW ILLUSTRATED BULLETIN; or for help on any industrial rust prevention problem, call or write: E. F. Houghton & Co., 303 W. Lehigh Ave., Philadelphia 33, Pa.

When preserving for military use specify **COSMOLINE 377** (Conforms to MIL-C-14201A, Grade 2)

COSMOLINE / RUST VETO

Most famous names in rust prevention

...products of

E. F. HOUGHTON & CO.

Ready to give you on-the-job service

Philadelphia, Pa. • Chicago, Ill. • Carrollton, Ga. Detroit, Mich. • San Francisco, Calif. • Toronto, Canada

◄ CIRCLE 217 READER SERVICE CARD

▲ CIRCLE 219 READER SERVICE CARD

Reduce Costly Wear on Air Equipment

Pipe scale, pipe dope, condensate, emulsified and deteriorated compressor oil — all damaging to connected air equipment — are inherently present in all compressed air systems. Provide for the efficient removal of these contaminants and assure top performance from air actuated devices by specifying a Norgren Air Line Filter in your design.

- 99 Models to choose from—⅛", ¼", ⅜", ½", ¾", 1", 1¼", 1½" pipe sizes.
- Choice of 4 Filter Elements—74, 64 or 25 micron . . . 5 micron available in some sizes.
- Transparent or Metal Bowls
- Wide Operating Pressure Range—Top efficiency at pressures as low as 5 psi—as high as 250 psi for metal bowl type.
- Wide Operating Temperature Range—Metal bowl models extend temperature range to 200° F.
- Automatic or Manual Drain—Automatic drain eliminates maintenance cost for draining manually.
- Abrasive Solids and Corrosive Liquids—are removed from air lines, reducing equipment wear, repair and replacement costs.

NEW Clamp Ring FOR FASTER, EASIER MAINTENANCE

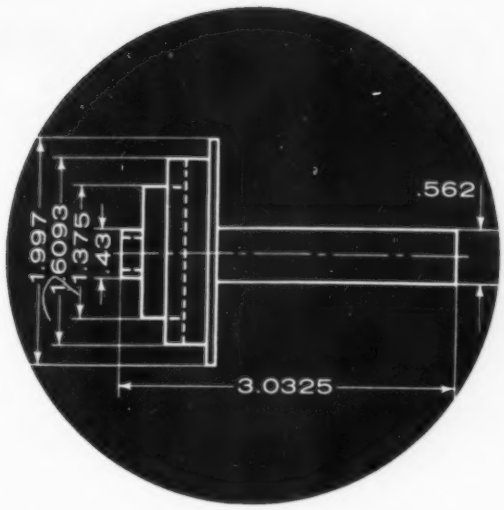
. . . most Norgren Filters now have a new, improved clamp ring, featuring a quick-opening spring clip that securely locks it in place—no tools required for servicing filters.

For complete information,
call your nearby Norgren Representative listed in your telephone directory—or WRITE FOR DESCRIPTIVE LITERATURE.

If it's Norgren . . . It's Dependable.

C. A. NORGREN CO.

3436 SO. ELATI STREET • ENGLEWOOD, COLORADO



the shortest distance between these two points...

Carpenter stainless steel

The time you save may be your profit on the job—especially when the job is an intricate machining operation on stainless steel parts. You can fully expect to save more time on stainless machining when Carpenter steel is used, because Carpenter has developed special grades that surpass any others in machinability. More than faster speeds, Carpenter customers have also come to depend (and profit) from longer tool life and better surfaces. If you don't believe that Carpenter stainless can surpass the steels you are now using, prove it to yourself on your next production run. The Carpenter Steel Company, Reading, Pa.

Carpenter steel

The Carpenter Steel Company, Main Office and Mills, Reading, Pa.
Alloy Tube Division, Union, N. J.
Webb Wire Division, New Brunswick, N. J.
Carpenter Steel of New England, Inc., Bridgeport, Conn.

ARMSTRONG

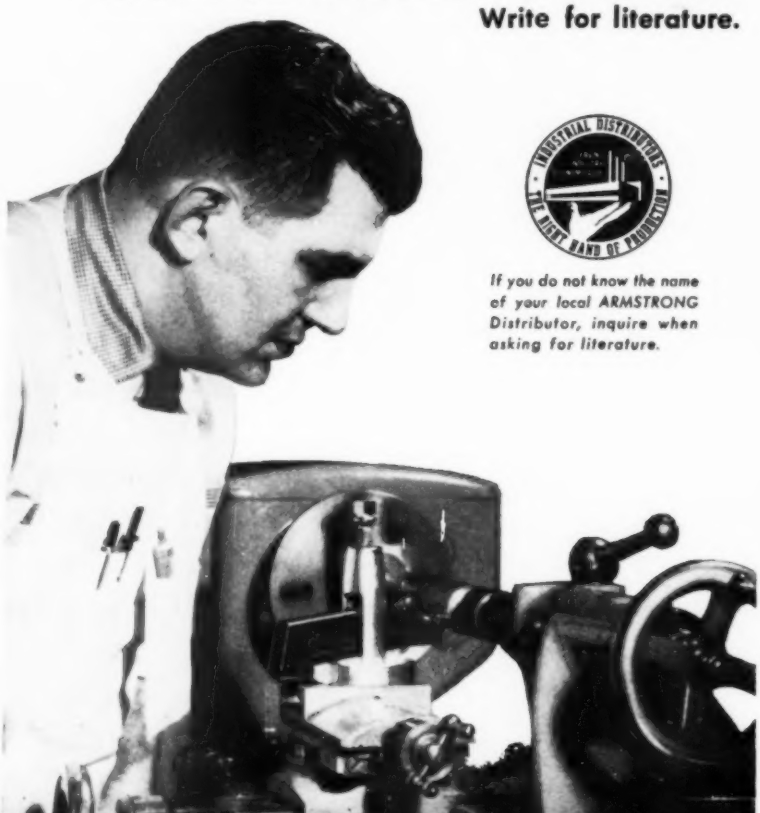
TOOL HOLDERS

A Correct Tool for Every Lathe Operation

You can save time (and money) by ensuring that your machine tools are equipped with *adequate numbers* of the correct ARMSTRONG Tool Holders. The ARMSTRONG System of Tool Holders includes correctly designed tools for *every* standard operation on lathes, shapers, and planers, and for many operations on turret lathes and screw machines. By utilizing the ARMSTRONG System of Tool Holders, you can reduce tooling costs, eliminate down time in tooling up, operate your machine tools at maximum feeds and speeds.

ARMSTRONG Tool Holders are long-lasting tools. They are strong beyond need, handy and efficient, profitable to use, and are readily available from your local ARMSTRONG Distributor.

Check over your ARMSTRONG Tool Holder needs. Write for literature.



INDUSTRIAL DISTRIBUTORS · THE RIGHT HAND OF PRODUCTION

If you do not know the name of your local ARMSTRONG Distributor, inquire when asking for literature.

ARMSTRONG BROS. TOOL CO. 5215 W. ARMSTRONG AVE. CHICAGO 46, ILL.

WHATEVER YOU WANT A PRESS TO DO...

THERE'S A BLISS PRESS TO DO THE JOB BETTER!

Bliss makes more types and sizes of presses than any other builder

No matter how big or how complex that next metal stamping job may be, it makes sense to call on Bliss. Size never has presented any problem to us, and complexity is our specialty. And because Bliss makes more types and more sizes of presses than any other builder in the business, you're sure to get impartial counsel—sure that your trained Bliss representative will "grind no axe" for any one type of press. And remember this: he's backed by more than a century of experience in building presses of all types, all sizes, for all kinds of industry.

BLISS
SINCE 1857

BLISS is more than a name it's a guarantee

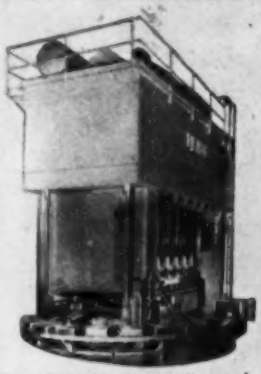
E. W. BLISS COMPANY, Canton, Ohio

PRESSES • ROLLING MILLS • ROLLS • DIE SETS
CONTAINER MACHINERY • CONTRACT MFG.

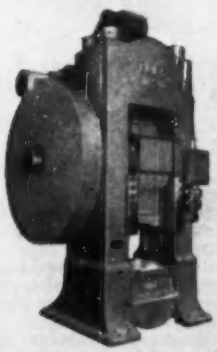
INCLINABLE PRESSES . . . in bench, single or double crank, modern enclosed design. With air friction or mechanical clutches, and whatever you need in cushions and feeds.

STRAIGHT SIDE PRESSES . . . eccentric and crankshaft models . . . any size . . . modern enclosed design, with whatever automatic features you want.

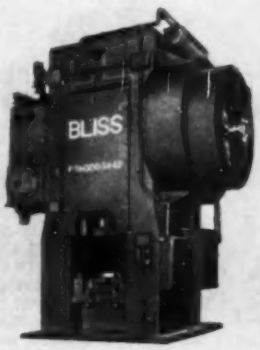
HIGH PRODUCTION PRESSES . . . specially designed for continuous high speed automatic operation. Up to 1000 spm. Available in a variety of sizes . . . and precision feeds.



TRANSFER FEED PRESSES . . . for the ultimate in production. Bliss pioneered the development, now builds them for blank or coil stock work, with no limit on size.

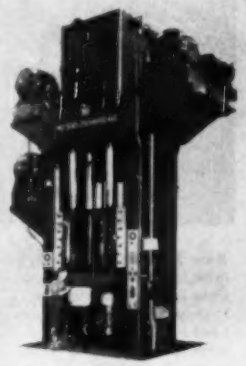


KNUCKLE JOINT PRESSES . . . for slow, powerful application of pressure at near-bottom stroke. Bliss builds them from 75 to 10,000 tons capacity in 40 standard models for coining, embossing, extruding, sizing and swaging.



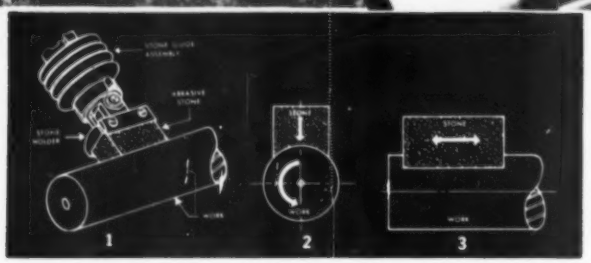
FORGING PRESSES . . . for production of turbine blades, crankshafts — hot forging, cold coining and other operations. Built in a number of sizes, from 300 to 4000 tons capacity, to standard and special design.

TOGGLE PRESSES . . . Double and triple action designs with quick advance and return speed features; modern electronic controls and automatic lubricating systems. From giant "automotive" sizes to compact units for small parts.



HYDRO-DYNAMIC® PRESSES . . . single action or double open rod construction or closed, 20 tons capacity to 35,000 or even more, standard design or special high speed models, electronic controls —Bliss has built them all.

There's a NEW word in metalworking...



How Microstoning Works . . . (1) Supfina Attachment mounts quickly on lathe tool post. Pressing pushbutton valve extends stone guide, brings abrasive stone into contact with work. (2) Due to bonding material, stone quickly conforms to shape of workpiece. Constant downward pressure on stone maintains uniform abrading action and produces a controlled micro-inch surface finish. (3) As work rotates, stone is oscillated parallel to the work axis. Lathe power feed carries the stone the full length of the work. Typical applications include: roll finishing, bearing surfaces, machine tool spindles, guide pins, piston sealing rings, precious metal rolls and electroplating preparation.

Taft-Peirce SUPFINA produces

Here is metalworking's biggest breakthrough in twenty-five years of finishing improvements . . . the new Taft-Peirce Supfina machine tool attachments, originated in West Germany and developed and manufactured by Taft-Peirce for exclusive sale in this country.

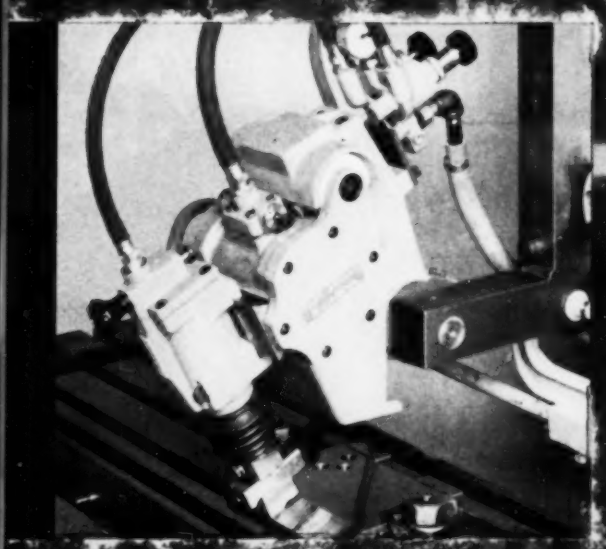
So remarkable are the results that a new word had to be coined: "Microstoning." Microstoning is an abrasive final finishing process that generates a *controlled* micro-inch finish on practically any material and at the same time corrects geometrical errors caused during previous machining.

Completely versatile and easy-to-use . . . Taft-Peirce Supfina attachments can be used on all machine tools with-

CIRCLE 223 READER SERVICE CARD ▲

CIRCLE 224 READER SERVICE CARD ►

MICROSTONING!



TP 9-16

revolutionary $\sqrt{\frac{\text{controlled}}{\text{micro-inch}}}$ surface finish and geometric correction

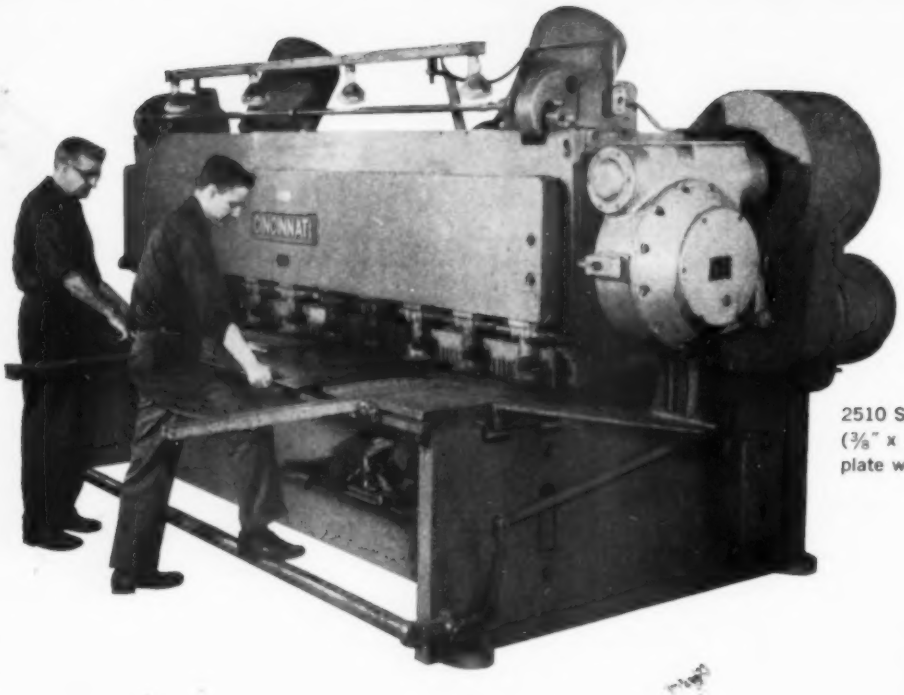
out modification and can be operated in any position by using standard mounting bars. Set-up is quick and easy.

Low in price, minimum maintenance . . . Because Taft-Peirce/Supfina is a machine tool attachment, your first cost is small. And Supfina has been ingeniously designed for trouble-free operation.

Many savings opportunities . . . Supfina does its job extremely fast. Final finish can be attained in a matter of minutes, and there are many short-cut possibilities, such as elimination of surface grinding, salvaging of rejects, simplified geometrical correction and the unique opportunity to improve product quality without increasing costs.

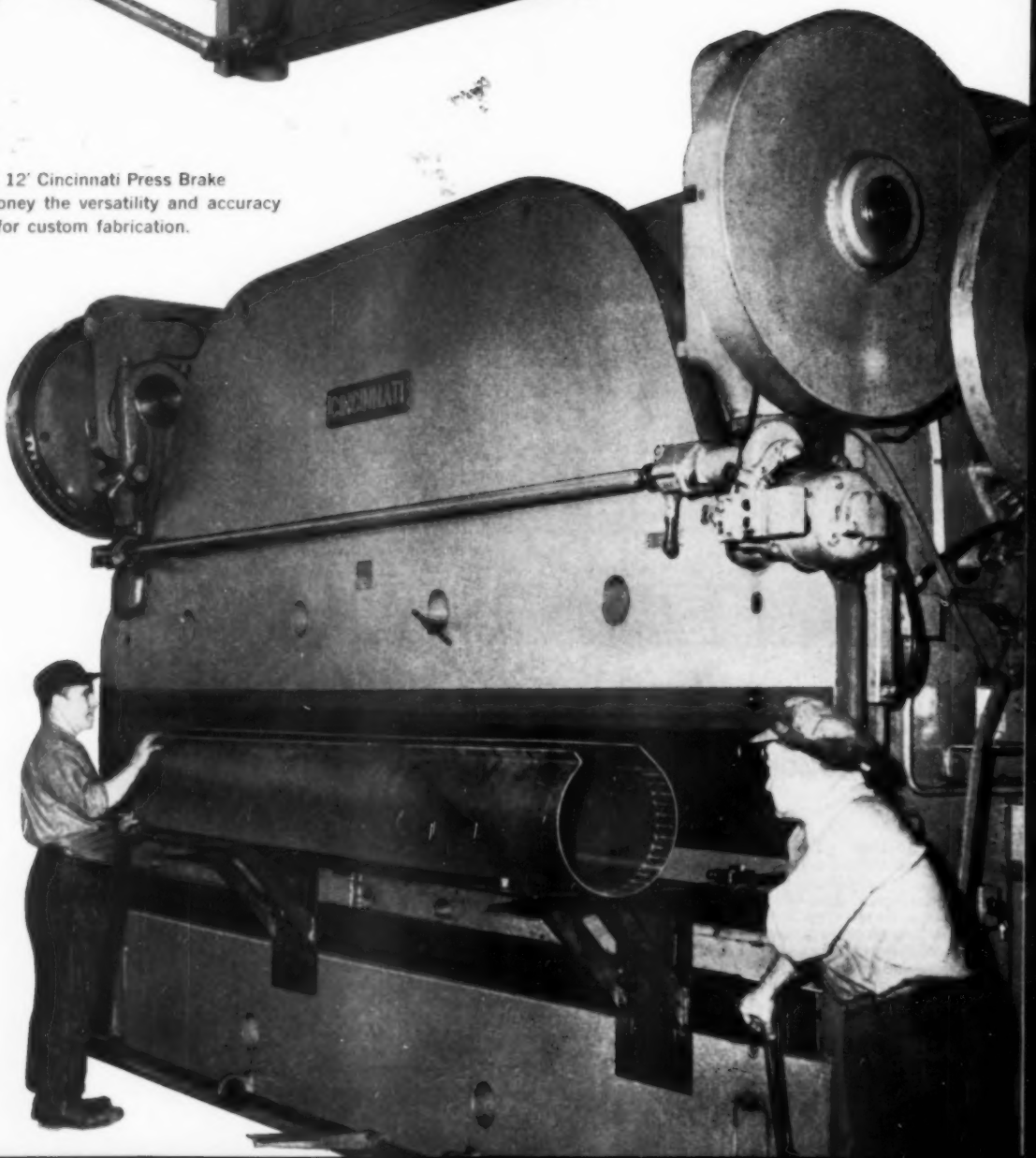
Find out about Microstoning and Taft-Peirce/ Supfina, now! No matter what your present finishing system is, you should investigate the dynamic breakthrough of Microstoning and Taft-Peirce Supfina. Call or write for complete information. Taft-Peirce Manufacturing Company, 13 Mechanic Avenue, Woonsocket, Rhode Island.

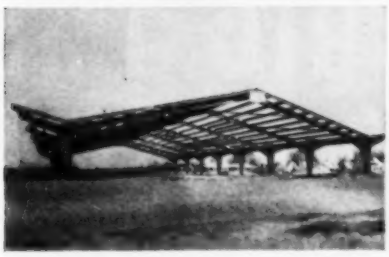
Finish it with **TAFT-PEIRCE** *SUPFINA*



2510 Series Cincinnati Shear (3/8" x 10' capacity) cuts steel plate with consistent accuracy.

13 Series 12' Cincinnati Press Brake gives Mooney the versatility and accuracy required for custom fabrication.





"From brackets to buildings," Mooney Iron Works Co. fabricates steel products on maintenance-free Cincinnati Press Brake and Shear.

"Not a penny's worth of maintenance since 1953!"

"We haven't spent a penny on maintenance of our Cincinnati® Press Brake and Shear since we got them in 1953," says John L. Mooney, President of Mooney Iron Works Co., Cleveland.

Yet these two machines have been worked hard, day after day, in Mooney's fabrication of structural steel products which range "from brackets to buildings."

By keeping costs down, this extra-rugged Cincinnati stamina helps Mooney compete aggressively and get new business. You can earn these same profits; put Cincinnati Press Brakes and Shears to work in your shop.

Write Dept. A for Bulletin CS-4, which covers all Cincinnati equipment.

Shapers / Shears / Press Brakes

THE CINCINNATI SHAPER CO.

Cincinnati 11, Ohio, U.S.A.

◀ CIRCLE 225 READER SERVICE CARD

▲ CIRCLE 226 READER SERVICE CARD

OK, OK... SO YOUR NEW ALL-ELECTRIC IMPACT HAMMER IS FAST - BUT WHAT ELSE WILL IT DO FOR ME?

Fair question. ELECTROPUNCH is fast. Up to 300 controlled blows per minute. Up to 10,000 lbs. impact. Swift lift for any light assembly production line. But not just fast. No. Versatile. Excellent for staking, riveting, punching, swaging, crimping, marking, etc. Mobile, too. Oh yes. Takes up mere square foot of bench. Fits any production line — just plug it in. Electric, you know. Won't affect air line requirements. Never have to buy new air compressor or any of that costly business. Saves utility costs like bees save honey. And, speaking of saving: No maintenance. Just two moving parts — yet durable as Gibraltar. Easy, effortless operation — but really effortless. Easiest of all on budget. Blush to mention actual figure. But cost is lower than for any comparable equipment. Get facts. Write: **BLACK & WEBSTER, INC.** Dept. 3, 570 Pleasant St., Watertown 72, Mass.
PHONE: WALNUT 6-0100

NEW IMPROVED SERIES 4 ELECTROPUNCHES — MODEL BS

Impact, 3500 lbs. (others to 10,000 lbs).
Length of stroke — 1¾"
Cycles per minute, full stroke — 120
Maximum shut height — 5½"
Column Height — 12" (18" column slightly extra)
Throat depth — 4"
Tool hole in spindle — .500-.502x 1" deep
Bench space — 9¼" x 9¼"
Weight — 50 lbs.
Power consumption — 111,000 strokes for 1 KWH
115V., or 230V., AC, 50-60 cycle, 1 phase

NEW HAMPSHIRE BALL BEARINGS, INC.
PETERBOROUGH - NEW HAMPSHIRE

ARTHUR N. DANIELS
PRESIDENT

July 13, 1959

Mr. N. A. Leyds, General Manager
Bryant Chucking Grinder Company
Springfield, Vermont

Dear Mr. Leyds:

It is a pleasure to congratulate you for your Company's development of the new miniature Centalign internal grinders, from our point of view the outstanding machine tool design of the past ten years.

I feel that your engineers, designers, production people and those who made this decision are to be highly commended for this achievement.

Sincerely,

A. N. Daniels
President

AND/im

BRYANT CHUCKING GRINDER CO.
10 CLINTON STREET, SPRINGFIELD, VERMONT

BRY-ALIGN CENTALIGN

Announcing

—AN ENTIRELY NEW LINE OF V-BELT DRIVES

NEW HIGH CAPACITY!
NEW SMALL SIZE!
MANY NEW SAVINGS!

Dyna-V is entirely new. In every detail, Dyna-V has been engineered to take advantage of today's great improvements in belt materials and metal alloys—resulting in V-belt drives that are sensationally compact.

Dyna-V is capable of handling up to three times as much horsepower in a given space. Dyna-V opens vast new possibilities for better, more economical machine design. And, in most instances *Dyna-V costs less!*

An entirely new high in strength and horsepower capability is packed into Dyna-V Belts. Cross section dimensions are substantially reduced—top width is much narrower. Dyna-V Sheaves are designed for these belts. Narrower grooves reduce face width—and weight. Costs are lowered. Smaller diameter sheaves and shorter center distances multiply savings.

Increased sheave strength for increased capacity is obtained through changes in design that utilize the full benefit of modern improvements in alloy metals. Dodge is noted for the superiority of its semisteel castings, to which now have been added ductile iron castings produced with the most modern electric furnace facilities.

Dyna-V Sheaves are equipped with Taper-Lock Bushings. The superiority of this mounting, patented by Dodge, is widely recognized. Taper-Lock's holding power is terriffic, yet it is "easy on, easy off." And Taper-Lock Bushings provide the additional advantage of interchangeability.

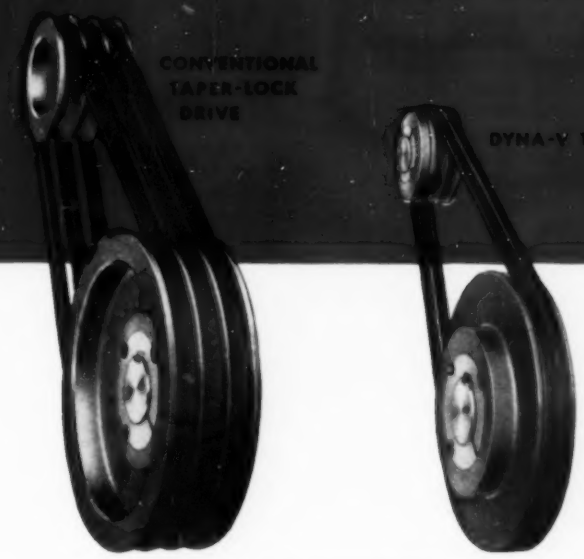
The benefits of Dyna-V go beyond compactness and initial low cost. Smaller sheaves reduce shaft overhang—increase bearing life. The dimensional stability of Dyna-V Belts (which are heat resistant, oil resistant, static conducting) solves the problem of belt matching. Every belt carries its full share of the load. The crowned top of Dyna-V Belts is a new concept in belt design. Combined with proved concave sidewall construction, it insures perfectly even load distribution between belt and sheave.

Write to us for the Dyna-V Bulletin which includes complete description of these new drives, selection tables, horsepower ratings, etc. Or see your local Dodge Distributor.

DODGE MANUFACTURING CORPORATION
100 Union Street, Mishawaka, Indiana

DODGE

DODGE Dyna-V



Dyna-V Drives for capacities up to 50 hp use the new "3V" belt cross section and Dyna-V Sheaves to match. Dyna-V Drives for capacities up to 200 hp use the new "5V" belts and sheaves. Both sizes available from Dodge distributors' stocks. Larger sizes up to 1500 hp with "8V" belts and sheaves can be furnished on order.

Dodge continues to manufacture the conventional Taper-Lock Sheaves using industry's standard A, B, C, D and E cross section belts, the hp ratings of which have been increased an average of 40% without any increase in cost.

COMPARISON, ILLUSTRATED ABOVE — 3 HP, 1750 RPM, 2.41 TO 1 RATIO

	BELTS		SHEAVES			CENTER DIS-TANCE	HP	WEIGHT (LBS.)	COST	
	Number	Size	O.D. Driver	O.D. Driven	Width				Per hp	Per Drive
CONVENTIONAL TAPER-LOCK DRIVE	3	A42	4.15"	8.95"	2½"	12.3"	4.62	24.7	$5.62	$25.98
DYNA-V TAPER-LOCK DRIVE	2	3V400	3.35"	8.00"	1⅜"	10.8"	5.0	18.0	$4.50	$22.50
% SAVING *Savings vary with different sized drives*			19%	10%	56%	12%	-+-	27%	19.9%	13.4%

CALL THE TRANSMISSIONEER—your local Dodge Distributor. Factory trained by Dodge, he can give you valuable help on new, cost-saving methods. Look in the *white* pages of your telephone directory for "Dodge Transmissioneer."

CAPEWELL

and its AUTHORIZED DISTRIBUTORS

announce a new metalworking advancement...

L-100-M

SPEED-BAND

Double Carbide BAND SAWS

This unusual new product, available only through Capewell Distributors is another reason why you should see your Capewell Distributor first for all your industrial needs.

CAPEWELL

THE CAPEWELL MFG. CO.
HARTFORD 2, CONN.

Letters...

To American Machinist
330 W 42nd St, NY 36, NY

More on explosives

Dear Sirs:
Here is my contribution on the subject of handling explosives (*AM*—July 27 '59, p62).

Mr Cooley is correct. We must remember that advertising films (which I did not see), showing the rough treatment RDX explosives may be given, are for the purpose of showing what may occur without incident but are not proof statistically that such malpractice is permissible. This is similar to the man who made a living at country fairs lighting and burning explosives in his hand until the fatal day arrived.

The comment that dynamite and other explosives detonate merely by thinking about them is absurd. No commercial or military explosive is unstable.

There are several conservative explosive companies who would gladly offer advice, based on experience gained over decades, to anyone contemplating handling explosives.

Robert McGirr
Orwigsburg, Penna

While we're on the subject, we'd like to correct a typographical error in Mr Cooley's letter referred to above.

The last time we saw the final paragraph on page 62 it said, "So far, explosive metal forming has a good safety record, so we sincerely hope none of your readers will pound, cut, or crush RDX."

Apparently, the paragraph was scrambled at the printer's in the process of being put on press—Ed.

Thousand-to-one error

Dear Sirs:
The article titled "Inert gas welding can be hazardous" by Mr Henry Allen is a very interesting one (*AM*—June 29 '59, p100).

In this article Mr Allen points out many hazardous conditions which can exist in inert gas welding. Mr Allen also points out that beryllium fumes are toxic above 2 milligrams per cubic meter of air per 8-hr shift.

The value of 2 milligrams per cubic meter of air is in error by a factor of 1000. This should read 2 micrograms or 0.000,002 of a gram per cubic meter of air per 8-hr shift.

We at this time are working

SHOPMATES

N. Jarvis

I CAN'T SEE WHY YOU GUYS HAVE TO TIE UP THE SAW WITH THAT BIG STUFF — I'LL HAVE TO CHANGE THE BLADE!!
IT'S THAT SMALL STUFF THAT RUINS A SAW — SNAGS THE TEETH AND BREAKS 'EM OFF!
THE WARP WILL BE BREAKIN' SOME TEETH WHEN HE CATCHES 'EM ALL LOAFIN'!!
N. JARVIS

CAPEWELL

announces

L-100-M **SPEED-BAND**

a new concept in band saw blades

From Capewell's famous Research and Development Laboratory comes the announcement of an important new metalworking development—Speed-Band

- Speed-Band is the first band saw blade to be produced from a new alloy specifically designed for band saw blades
- Speed-Band is made from a double carbide alloy formulated to deliver optimum performance by embodying those characteristics most needed for economic sawing
- Speed-Band's double carbide alloy provides the hot hardness and abrasion resistance which permit use at higher speeds and feeds on *standard* carbon band saw machines
- Speed-Band's hot hardness and abrasion resistance increases the range and types of materials which can be cut on standard carbon band saw cutoff machines
- Speed-Band's hot hardness and abrasion resistance qualities guarantee faster cutting and greater productivity
- Speed-Band's exclusive features greatly extend blade life, reduce blade changing and down time, and minimize tool risk.

Speed-Band is the first band saw ever to be designed and developed with the user and the end use in mind. The genuine Speed-Band is manufactured only by the Capewell Mfg. Co., and sold only through authorized Capewell Distributors.

THE CAPEWELL MFG. CO., HARTFORD 2, CONN.

Special note to buyers of capital equipment:

Speed-Band's greater potential on standard equipment can eliminate the need for expensive special machinery.

Speed-Band's increased performance potential allows standard carbon bandsaw machines to be operated to their full capability for the first time.

Speed-Band's flexibility permits its use on machines designed for high speed bands, and where applicable, can reduce tool cost substantially.

Before you buy, see your Capewell Distributor for all the details on Speed-Band, the *sensible* band saw.

LEADERS IN INDUSTRY MARK WITH NOBLEWEST

ROLL-O-MARK

MULTI-PURPOSE ALL-PNEUMATIC MARKING MACHINE

1 *Roll-Marking into Surface of Piston*
2 *Serial Numbering into Metal Shaft*
3 *Permanent Marking and Graduating into Metal Collar*

Model 50P1

This multi-purpose Roll-O-Mark can be set up faster . . . tooled up easier . . . accommodates attachments more readily than any other marking machine. With all-pneumatic operation, no motor or separate power unit is required. Simply connect to the shop's air line—air is used *only* when in operation. This multi-purpose metal marking machine offers many other advantages such as—5" die slide stroke . . . open throat design . . . hand wheel for rapid table elevation . . . independent control for set up.

Whatever your needs for metal marking, Noblewest makes the machines, marking dies, and work-holding fixtures for doing the complete job faster, better, at lower cost. And remember, Noblewest Roll Marking is *permanently* indented marking—*good for the life of your product.* Write for new catalog. The Noble & Westbrook Manufacturing Company, 17 Westbrook Street, East Hartford 8, Conn.

A mark is only as good as the die that made it. Noblewest steel marking dies are precision made indented marking.

A few desirable territories open to qualified representatives

MARK IT BEST WITH NOBLEWEST IMPROVED MARKING DEVICES

NOBLEWEST

ORIGINATORS OF THE ROLL MARKING PROCESS

MARKING
NUMBERING
EMBOSSING
GRADUATING

with beryllium compounds and have to keep our air within the 2 microgram limit. Above this limit we would consider the operation unsafe. I would greatly appreciate it if you would take any corrective measures which you deem necessary to rectify the error in Mr Allen's paper.

Laurence E Ferreira,
dir of research
Coors Porcelain Co
Golden, Colo

We stand corrected. A milligram is a thousandth of a gram, and a microgram is a millionth. As Reader Ferreira points out, we should have said 2 millionths of a gram or 2 micrograms per cubic meter of air.—Ed.

Hard chrome

Dear Sirs:
We noticed an article on "Improved Hard Chrome" (*AM*—July 27 '59, p4) which states, "A better plating technique for hard chrome has been introduced by Michrom Inc, Chicago, Ill . . ."

We would like to have all the information available on this subject. Could you please furnish us with the complete address of the above-mentioned company?

W G Stevens
Tupelo, Miss

The address is Michrom Division, Gits Brothers Mfg Co, 1838 South Kilbourn Ave, Chicago 3, Ill. The company should be able to supply the information you need.—Ed.

"Say, Charlie, I was just wondering—is this a work order you sent down or were you just cleaning your pen?"

CALENDAR

Pressed Metal Institute—National Meeting, Sept 13-17, Stanley Hotel, Estes Park, Colo.

Society of Automotive Engineers—Farm, Construction, and Industrial Machinery, Meeting and Display, Sept 14-17, Milwaukee Auditorium, Milwaukee, Wis.

American Die Casting Institute—Annual Meeting, Sept 15-17, Edgewater Beach Hotel, Chicago, Ill.

Instrument Society of America—Instrument-Automation Conference & Exhibit, Sept 21-25, Int'l Amphitheater, Chicago, Ill.

American Welding Society—National Fall Meeting, Sept 28-Oct 1, Sheraton-Cadillac Hotel, Detroit, Mich.

Society of Automotive Engineers—National Aeronautic Meeting and Display, Oct 5-10, Ambassador Hotel, Los Angeles, Calif.

American Society of Tool Engineers—Semi-annual Meeting, Oct 8-10, Chase-Park Plaza Hotel, St Louis, Mo.

American Society for Testing Materials—Pacific Area National Meeting, Oct 11-16, Sheraton Palace Hotel, San Francisco, Calif.

Society of Plastics Engineers—National Technical Conference, Oct 13-14, Ambassador Hotel, Los Angeles, Calif.

Magnesium Association—Annual Convention, Oct 19-20, Hotel Roosevelt, New York, NY.

American Institute of Electrical Engineers—Machine Tool Conference, Oct 19-21, Sheraton-Cleveland Hotel, Cleveland, Ohio.

National Safety Council—National Safety Congress, Oct 19-23, Chicago, Ill.

American Machine Tool Distributors Association—Annual Meeting, Oct 25-27, Statler Hotel, St Louis, Mo.

American Gear Manufacturers Association—Semi-Annual Meeting, Oct 25-28, Edgewater Beach Hotel, Chicago, Ill.

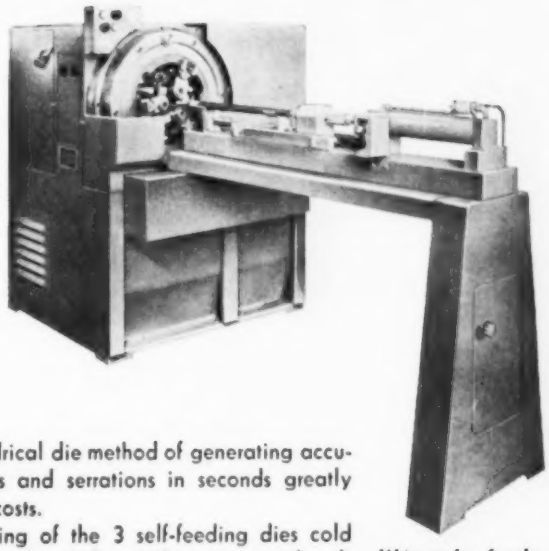
Reed 3-Cylindrical Die Machine

. . . produces splines faster with greater accuracy

It's Fast...

It's Accurate..

It's a Money Maker...



The Reed 3 cylindrical die method of generating accurate involute splines and serrations in seconds greatly reduces production costs.

The precise tracking of the 3 self-feeding dies cold forms the teeth with either 30° or 45° pressure angles. It gives greater tooth strength and better surface finish. The machine may be automated or equipped with a semi-automatic loading fixture.

Write today for detailed information.

If it can be rolled—write Reed.

REED SM-175

REED ROLLED THREAD DIE CO.

Specialists in Thread and Form Rolling Tools and Equipment

HOLDEN, MASSACHUSETTS, U. S. A.

Sales Offices in: Buffalo, Chicago, Cleveland, Compton, Calif., Denver, Detroit, Englewood, N. J., Houston, Indianapolis, Milwaukee, Montreal, New York City, Phila., Pittsburgh, St. Louis, Syracuse, Toronto

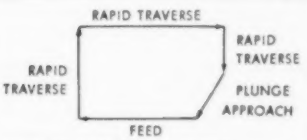
How to increase productivity with...

Multicycle Hobbing

Any one of these automatic cycles can be selected simply by turning a switch on the control panel.

SQUARE CYCLE – automatic version of the conventional hobbing cycle.

PLUNGE CYCLE – automatic vertical feed for cutting worm gears.



PLUNGE-APPROACH CYCLE – combination of "plunge" and "square."

Automatic cycling plus the opportunity to greatly reduce approach time in many cases makes the Multicycle version of the Barber-Colman No. 16-16 Hobbing Machine a high-production machine, and yet it is extremely versatile.

Reduce approach time

The new Multicycle machine offers three different automatic cycles (see sketch). Any of these can be selected simply by turning a switch. With the plunge-approach cycle for cutting helical gears and worms (or when using large, multiple-thread hobs), you can greatly reduce long approach time. With the push of a button, cam vertical feed and conventional horizontal feed cycle automatically. The hob starts cutting at full depth faster. Clamping and unclamping of the workslide is automatic. The operator just loads and unloads the work.

Automatic machines can be versatile, too!

To cut worm gears, turn the selector switch to "plunge," disengage the feed change gears, turn the dial control to proper cam speed, set the vertical stops, and push the start button. The workslide lowers rapidly to the cutting position. The work feeds slowly to full depth as it is being hobbed, and then dwells for the desired number of revolutions. When the hob stops, the workslide returns to starting position.

Is there a Multicycle machine for you?

You bet there is. These same features are available in the No. 6-10 machine. Additional equipment, such as differential gearing, accessory vertical feed cams, and even full automation, will adapt this precision hobbing machine to almost any job. Send us prints of your gears. We'll give you a complete report on the time saved by a Multicycle machine. Call your nearest Barber-Colman field office or the factory, WO 8-6833.

Barber-Colman Company

BARBER COLMAN

91 Loomis Street, Rockford, Illinois

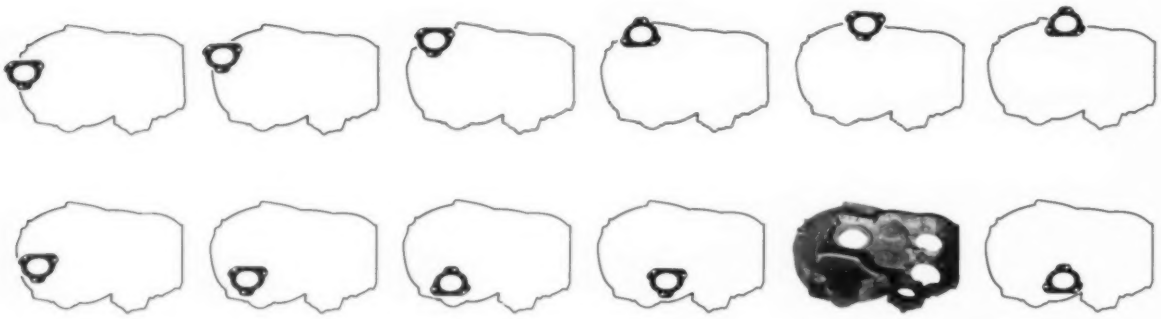
Right now! Numerical control like this can produce for you

. . . Turn the page to see how this Natco does it.

Tape Control Speeds Production

This workpiece comes in many varieties . . .

One multi-spindle Natco machines them all



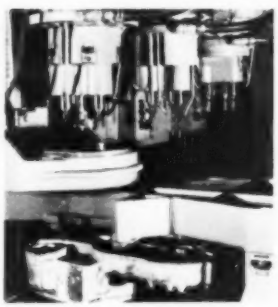
Numerical control for the production line? Sure! And it's paying its way machining starter holes in over 160 different flywheel housings for small diesels. Even though the starter mounting pads are located differently on each of the housings, this Natco handles each new part with equal ease. It bores the hole for the starter pinion shaft; drills and taps three mounting holes around it.

That's the beauty of tape control—the flexibility it gives machine tools like this three column Natco special. Here's practical automation for small lot production!

It's easy and fast to change to a different part. Just substitute a new tape loop in the reader and rotate the drillheads to the new setting. In minutes you're cutting metal again.

No battery of expensive fixtures needed with this machine—the tape locates the part under the drillheads by controlling the motion of the worktable. And inventory can be cut to the bone because even small lots of service parts are run at production part cost.

Production lines don't have to wait until tomorrow for numerical control. It's here now, and now is the time to gain the greatest advantage. Let us show you how it can be used to speed your boring—drilling—facing—tapping—reaming jobs. Call your Natco representative today, or write for details.



NATCO NATIONAL AUTOMATIC TOOL COMPANY, INC., RICHMOND, IND.

SPOT NEWS...

- **Chrysler now has a plant that turns out just one car a day.** Idea of the plant is not to produce cars but to test every part and tool involved in building 1960 Chrysler makes. Chrysler figures this method will iron out any bugs before cars are delivered to owners.
- **Electronics industry in the 11 Western states has been doubling** every three years in volume, is billing $2 billion this year, something like 40 times the business it did just 15 years ago.
- **Late news on the Cross Co (Detroit) strike:** The Cincinnati Circuit Court has ordered the NLRB to show cause by September 10 why the bargaining election won last November by UAW Local 155 should not be set aside (see *AM*—Aug 24 '59 p83). NLRB hearing on UAW's unfair labor practice charge against Cross Co has been delayed indefinitely. Macomb County (Mich) Circuit Court has limited pickets to 20, but violence continues intermittently. Plant is said to be operating at 50% of prestrike rate.
- **Chrysler is reportedly readying a small power steering unit** for its compact car, the Valiant. Also reported: Ford is trying to keep the retail price of its Falcon compact car down to $1975.
- **East German passenger cars will be produced in Argentina.** First, East Germany's Wartburg will ship in parts and assemble them at Santa Fe. Later it will build a plant at Sauce Viejo.
- **Some 1300 Pacific Northwest IAM shipyard workers were on strike** at press time, halting $100 million worth of construction, and idling about 8000 fellow shipyard workers who refused to cross picket lines. Asked by the union: 15¢ an hour more, plus 10¢ more for a pension fund, and another 7¢ an hour raise effective July 1, 1960. Employers have okayed all but the current 15¢ rise, offer 7¢ instead.
- **Stainless steel structural components that can be bonded together** with ceramic material are being researched and developed by Boeing-Seattle under contract from the Navy Bureau of Aeronautics. Project will evaluate use of ceramic adhesives at temperatures up to 800 F.
- **Now you can lease closed-circuit television for industrial applications.** Lease base periods range from 1 to 6 years.
- **Import steel depot has been set up at Lake Calumet Harbor,** south of Chicago on Lake Michigan. Already in stock: bars, structural shapes, plate, reinforcing bars, nails and wire products.
- **New leasing firm will buy land, erect and completely equip a plant,** and deliver it to a lessee ready to go into production. Plan marks the entry of New York's Tishman Realty & Construction Co into such leasing fields as: industrial and materials handling equipment, electronic and electrical equipment, road-building and maintenance equipment; trucks, tractors, trailers and buses—even executive aircraft.
- **Crash-program for development of a "revolutionary" automatic transmission** has been launched by Curtiss-Wright Corp. Prime objective: to develop an automatic transmission that will use less fuel than present ones.
- **Process for making thin chromium sheet with a purity of 96%** has been developed by London's Metal Diffusion Ltd. Thin sheet steel pattern is used, which disappears during the process and is replaced by a chromium sheet of similar dimensions and finish.
- **Drop in employment** among military and civilian airframe production workers from present 342,000 to 275,000 by mid-1961 is forecast by Aerospace Industries Association, based on reports from 14 major airframe makers . . . and by end of 1964, a further drop to 215,000 is expected. Missile production, however, is expected to take up the slack.

420

GAGES FOR MISSILE HARDWARE

Manufacture of missile hardware is admittedly exacting. A good healthy respect for dimensional precision is imperative for reliable missiles. Likewise the specialized equipment to assure the necessary high order of dimensional control.

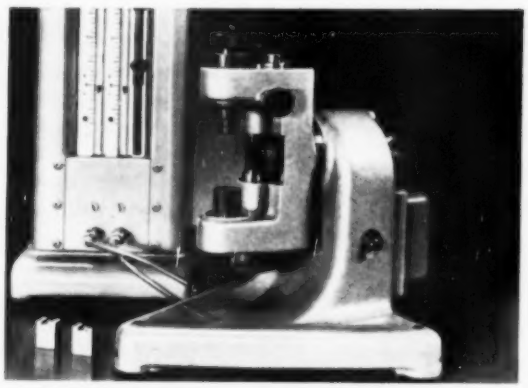
From the outset of the missile era, Sheffield has led the gage development work in this field. Close liaison is constantly maintained with missilemen of the Armed Services. Recourse to the facilities of the Eli Whitney Metrological Laboratory and consultation with its professional staff are always immediately available.

As a result, Sheffields' contributions have materially aided in the dimensional control of many missile components such as:

- **Nose cone assembly**
- **Elements of guidance systems**
- **Units of the propulsion system**

Precisionaire Gage for accurately determining the thickness deviation of a nose cone at 128 points around its periphery from base to apex.

This assembly of Sheffield instruments automatically delivers a printed record of single or multiple dimensions. It also computes and records the difference in related dimensions.



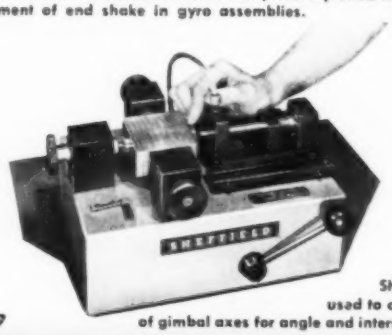
Combination inspection gage and assembly fixture with 2-column Precisionaire instrument permits precise adjustment of end shake in gyro assemblies.

For specific information on your particular problem write to **The Sheffield Corporation, Dayton 1, Ohio, U.S.A., Dept. 1.**

the **SHEFFIELD** corporation

of Bendix Aviation

manufacture and measurement for mankind



Sheffield gages are used to check relationship of gimbal axes for angle and intersection of planes.

8147

WASHINGTON...

Congressional outlook...

The first session of the Democratic-controlled 86th Congress is adjourning. And what had promised to be a fiercely anti-business session—in terms of legislation and price and monopoly investigations — turned out to be relatively friendly to the industrial community as a whole.

But as Congress goes home, it leaves behind some unfinished business of interest to industry. Some of the big issues sure to turn up again next year: A hike in the $1.25 hourly minimum wage and extension of the law's coverage; federal aid to depressed areas; pre-merger notification; power for the Attorney General to issue civil subpoenas for company records and other pertinent documents on the mere suspicion of an anti-trust violation; and a requirement that big companies in major industries submit to federal fact-finding before increasing prices.

The last question, however, will be quietly shelved if the inflation scare finally subsides. But an inflationary steel settlement, for instance, would add a new push behind the price notification scheme.

Tax cuts under study...

The most comprehensive study of the federal tax code since the 1953 changes makes some cuts a possibility this fall. Chairman Wilbur Mills, (D, Ark) of the House Ways and Means Committee has scheduled detailed hearings on all aspects of taxes, is looking for ways to broaden the tax base, remove inequalities, and so make room for a general cut in rates.

Changes in depreciation laws and fast tax-writeoffs long pushed by business will get special attention.

But there's no certainty that taxes generally will be reduced next year. The Administration is for it, but only after the budget is balanced and the debt lowered.

Representative Mills has scheduled a panel of tax experts for a public discussion on depreciation before his committee on November 11.

The panel will consist of Joel Barlow, attorney for the National Machine Tool Builders Association; George Terborgh of the Machinery and Allied Products Institute; Maurice Peloubet, New York accountant; Robert Eisner, Northwestern University economics professor; George Kitendaugh of GE; Fred Weston, U of California economics professor; Joel Dean, Yonkers, N Y, consultant; William Paton, U of Michigan accounting professor; Evsey Domar, MIT economics professor; and James Polk, New York attorney.

Defense spending leveling off...

The most stable level of military spending since World War II is now in sight, with a plateau of $41 billion (give or take a couple hundred millions) forecast annually for at least three successive years. Some $17 billion to $18 billion of the total will continue to be earmarked for research, development, and hardware output.

The leveling-off began in fiscal 1959 just ended, will continue during the current fiscal year, and will be carried into fiscal 1961 starting next July and beyond — barring US-Soviet agreement on an enforceable and inspectable disarmament scheme (which is unlikely).

Despite Wall St's reaction to the upcoming Eisenhower-Khruschchev exchange of visits, which has depressed prices of defense-related stocks, the leveling-off in defense outlays has nothing to do with the aura of good will generated by the scheduled White House-Kremlin talks. Stabilizing military spending has been a long-time administration objective, delayed up to now by Sputnik and rising arms costs.

From an economic view, the leveling-off in military expenditures will mean a lessening of the Pentagon's role in the national economy—and undoubtedly in the market for metalworking industries.

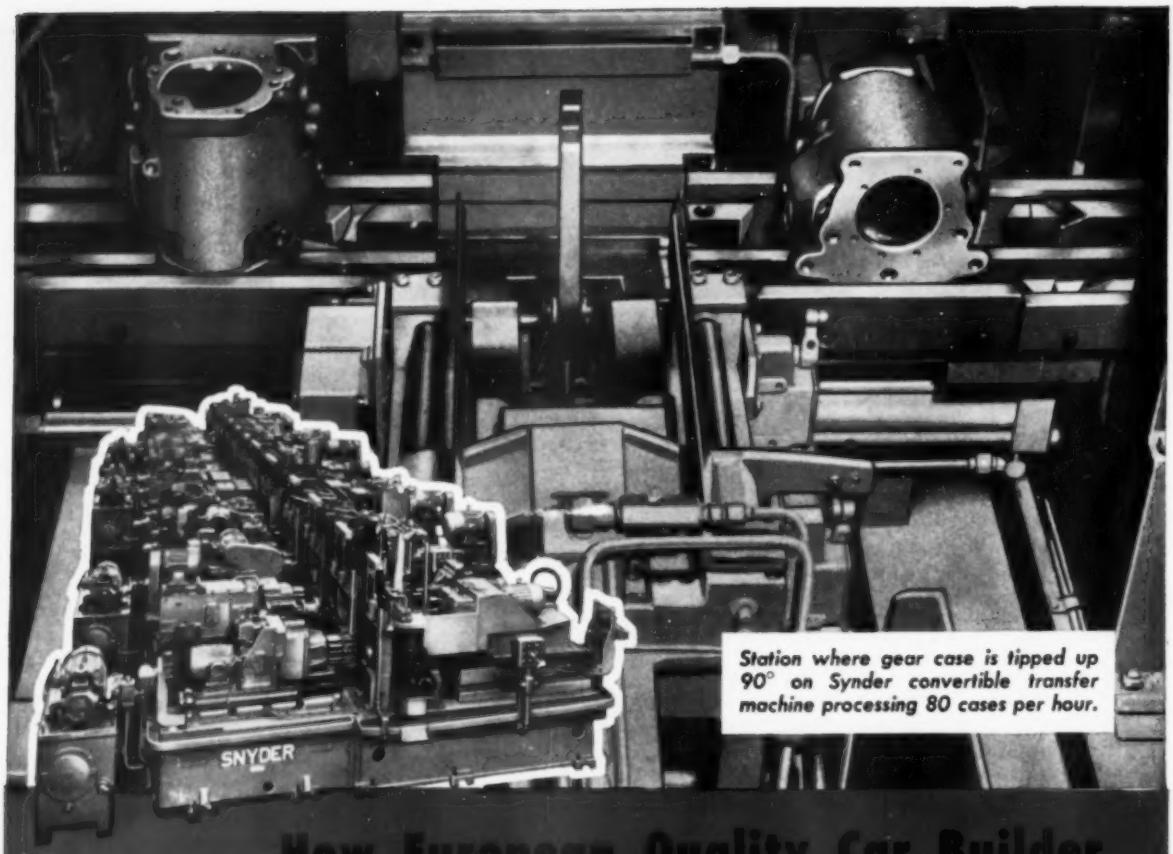
To be sure, a $41-billion slug still constitutes a mighty prop to U S business. And in local special cases the military dollar will remain the dominant economic fact. But the general impact of defense expenditures will be softened: the Pentagon's outlays are being stabilized while the Gross National Product continues to climb.

To maintain the plateau in spending, the Defense Dept is faced with a series of stretchouts or cuts in major programs. For as schedules stack up now, a big boost in spending is inevitable. This month, the Services submit budget proposals for next year. As usual, their preliminary requests exceed the Pentagon's total budget ceiling.

So for the next three months, Pentagon bureaucrats will scramble to cut the budget down to the size ordered by the White House.

The key issues to be decided: at what rates to continue output of manned bombers and fighters —if at all; the rate of spending for modernizing the Army; the future of the Titan ICBM project; whether to authorize production of the Army's experimental Nike-Zeus anti-ICBM system; how fast to modernize MATS with jet transport planes; the rate of spending for construction of new Naval destroyers and frigates, anti-submarine forces, and Polaris-armed nuclear subs.

◄ CIRCLE 238 READER SERVICE CARD



Station where gear case is tipped up 90° on Synder convertible transfer machine processing 80 cases per hour.

How European Quality Car Builder Snyderizes for the Soaring Sixties

This new 53-station transfer machine combines special purpose efficiency with high convertibility for later changes. Part orienting devices enable Snyder to utilize standard horizontal way-type units to drill, spotface, chamfer, ream, line-ream, mill and bore this cast iron standard gear transmission case on all faces. The cases are turned 90° at the thirteenth station and tipped up 90° at the thirty-eighth station, which eliminates vertical machining units. The part is specifically located on faces not subject to future design changes, thus reducing future capital expenditure.

* * *

Let us show you how to SNYDERIZE FOR THE SOARING SIXTIES for more efficient parts handling, gaging, assembly and machining. Send or phone for new brochure with resume of Snyder machines engineered for profit improvement.

Standard Features of Snyder Machines

1. SNYDER SELF-CONTAINED UNITS and other units equipped with hardened and ground steel ways.
2. Threading and tap heads equipped with individual lead-screw spindles.
3. Minimum downtime for tool changes because spindles are arranged for pre-set cutting tools.
4. Automatic lubrication.
5. J.I.C. Standards throughout.
6. Electrical interlocks and full depth circuit throughout.
7. Panels equipped with SNYDER CIRCUIT SLEUTH.

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TRENDS

DETROIT...

Gas-turbine breakthrough...

The first of 13 gas turbines, designed for use by industry and the military, has just been completed by GM's Allison Division. All 13 turbines are prototypes, the last of which will be delivered by year's end. Each costs $35,000.

One will be used for over-the-road trucks, one by an off-the-highway equipment user, three will go to an oil company, eight to the military.

Sometime next year GM Allison expects to be in volume production of turbines, and to bring the cost down from $35,000 to about $5000—a figure competitive with turbo-charged diesels of equivalent horsepower.

Allison's unit is a GMT 305 turbine rated at 225 hp and weighing 650 lbs. It occupies only 16 cu ft of space (compared to 25 cu ft for a 225-hp gasoline engine, '0 cu ft for a diesel).

This could mean a major breakthrough in bringing gas turbines into general commercial application.

The GM Allison development ties in with Chrysler Corp's research and development contract with the Detroit Ordnance District to install Chrysler's latest experimental turbine in a 14,000-ton GVW Dodge truck in the coming year.

Chrysler has been pushing turbines for some time, has been among the most enthusiastic about their future. Trial runs of turbine-powered Plymouths have gained wide publicity in the last couple of years, but so far Chrysler has made no mention of production models.

At a recent press conference, Chevrolet displayed its turbine-powered Titan II, equipped with a turbine similar to that Allison is producing. But even though the Titan II has been extensively road tested, Chevrolet regards it as a purely experimental unit, so far has no plans for putting it into production.

More on the "Air Cars"...

Curtiss-Wright Corp last month announced that it would be in production by November of an automobile that rides on a cushion of air (AM—Aug 24 '59 p61) but so far has not announced what its production figures will be. All that is known is that the car will be introduced initially to various industries to meet special requirements, that it will be a 4-passenger, 300-hp sedan with 2 engines that travels up to 60 mph, 6 to 12 inches above water or land. The car will be 21 feet long, weigh 2800 lbs.

But now England's Sanders-Roe Ltd (which already has tested an air car by running it across the English Channel at 25 mph) is designing an 83-foot-long ferry on the same principle, capable of carrying 100 passengers at 70 mph.

Getting into the air car act, too, is Spacetronics of Washington, D C, which will build a unit to travel over water down the East Coast to Florida. The craft will be designed to ride 16 to 24 inches above the water's surface at a top speed of 100 mph, will be 26 ft long, 20 ft wide.

Ford is working on a form of air car, too, has already demonstrated to the press an air scooter which it feels is the forerunner of air trains that will be propeller driven at 300 to 400 mph.

Outlook for the 1960 models...

With changeover to 1960 models still going on, production of 1959 cars hit its low point as August drew to a close—31,797 passenger cars and 14,975 trucks and buses (compared to 1959's peak weekly output of 163,340 vehicles during the week of May 11-16).

Looking ahead to 1960, automakers are without exception optimistic. Wearing the rosiest of rose-colored glasses is American Motors' George Romney, who is confident that his firm will make and sell about 500,000 cars in the coming calendar year, despite introduction of the Big Three of compact cars rivalling AMC's Rambler.

Pontiac's S E Knudsen feels his car will show a 5% gain over 1959, and new Buick general manager Ed Rollert feels he can make and sell 20% more Buicks next year than this year.

In fact, none of the automakers expects a decline in car sales during the coming year.

Air suspension fizzle...

Air suspension, a popular topic among automotive experts a year or so ago, has now been relegated to the things-that-looked-good-at-first but-have-lost-their-sales-appeal-limbo.

Even though Cadillac will retain air suspension, most other makes that offered it as an option last year are dropping it.

Reason is that mechanical suspension has improved to the point where it's difficult to explain why a premium price should be paid for air suspension.

This does not necessarily mean air suspension is out the window for good, but it does mean air suspension must take a long step forward before it can replace mechanical suspension.

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WILL *YOUR* NEW BRAKE HAVE ALL THESE FEATURES AT LODGE & SHIPLEY'S LOW *STANDARD* PRICE?

NEW . . . Pitman Assembly redesigned for long life with little maintenance

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PROVED . . . One-piece, heat-treated, machined and ground Eccentric Shafts

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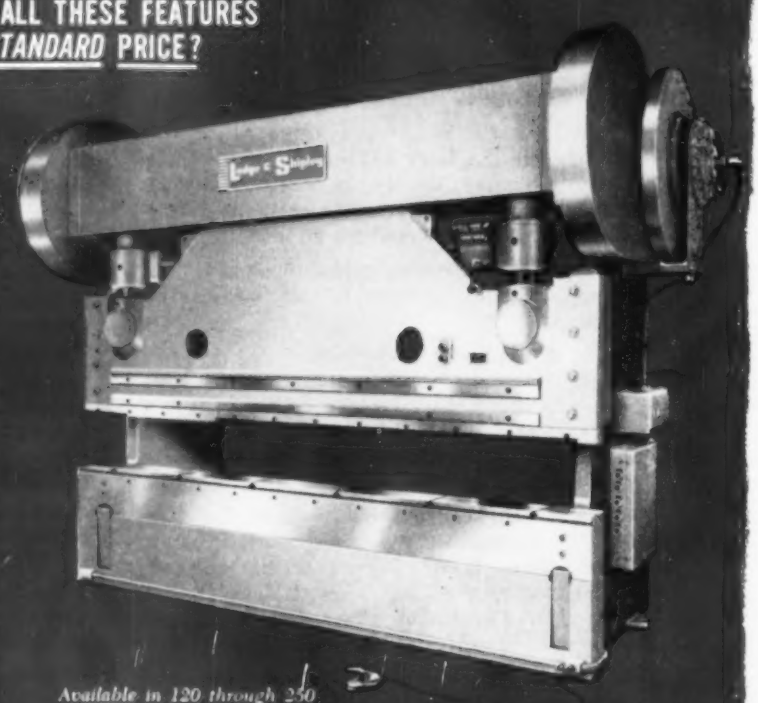
PROVED . . . Two full bearings on each eccentric shaft

NEW . . . Sectional die clamps on ram nose open automatically

NEW . . . Stroke Position Indicator shows top and bottom dead center

NEW . . . optional Two-Speed Transmission can be field-installed



Available in 120 through 250 ton capacities, bed lengths from 8 to 14 feet. Shown is Model Series 150A10 capacity 1/4" x 10' with above-the-floor bed.

New and completely redesigned, Lodge & Shipley Power Press Brakes offer feature after feature important to accurate, low-cost operation. Virtually every one of these advantages are included in the low base price . . . extras on the machine but *not* on the invoice and many of the models now have an above-the-floor bed!

Space limits us to a bare listing of important new features. Request your copy of the New Condensed Press Brake Catalog today. The Lodge & Shipley Co., 3056 Colerain Ave., Cincinnati 25, Ohio.

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More than ever before, your LODGE-ical choice . . . **Lodge & Shipley**

AIRCRAFT and MISSILES...

TRENDS

Cape Canaveral scoreboard...

Last year, 88 missiles of various shapes and sizes were fired from launching pads at the most important elbow of real estate in the Free World.

Some were spectacular successes, some spectacular duds. It was Cape Canaveral's "baby year"—a year for trial and error, a time for development of systems, range operations and launching techniques for everything from tactical missiles to scientific space probes and moon shoots.

This year the groping-in-the-dark feeling at Canaveral is gone. Now it's a case of "Let's get the show on the road." And there's a feeling of urgency in the air—Russia's awesome feat of sending into orbit a Lunik, with a thrust so powerful that it is so far equalled only on the drawing board in America, has been the spur.

It's been a mad, hectic race, this 1959, with its space probes, with its rumors of more probes to come—each more fantastic than the last. The public is edgy, wondering who's really ahead in the race for space—us or Russia.

The missile firms are very much aware that the U S public is running scared. Take a look at the stock market on a day when a launching fails, or when a particular missile makes a transition from one stage to another, or when a missile firm loses a contract or gets one.

Side by side at Canaveral are launching pads for Army Jupiters, with Pershings and Saturns to follow; Navy's Polaris; Air Force's Thor, Atlas and Titan. Each of the Services is intensely jealous of its share in the race for space. Each is out for a bigger share of the missile dollar.

But despite the intense inter-Service rivalry, Canaveral's record to date has been a good one.

True, some missiles haven't worked out as they were supposed to, but instrumentation has been in the right places at the right time, and telemetry has put the rockets on the right path.

This year, the Convair-produced Atlas has gotten the lion's share of attention at Canaveral. That's because this ICBM carries the prestige and hopes of the Free World until such time as the new Titan and Minuteman get into production.

Atlas, out of 11 shoots fired through mid-August, has had six failures, which were largely due to a faulty fuel flow valve. Since correction of the valve, Atlas has had three successful firings, boosting chances of making it operational sometime this month.

Douglas Aircraft's Thor-Able program has shown remarkable progress in the last year—but of 16 straight shots, only the last was a failure, and that was because of failure in programming, not in the missile itself.

Scientific probe shots have been held to a minimum this year, except for piggybacking of lab experiments on military missiles. Most notable of the few scientific probe shots: orbiting of the sun by Army's Juno II, and the recent carrying of 15 experiments in the 142-lb Thor-Able launched satellite.

National Aeronautic & Space Administration started out well last year with a successful Vanguard shoot, after the Navy had failed several times. Then NASA racked up a succession of failures with the Polaris until late in August, when the Polaris was fired successfully for the first time from a ship at sea.

Martin's Titan started out with remarkable success under NASA supervision too—five tests, five successes at Martin-Denver.

Then a Titan blew up on the test stand, and last month, the initial launching of the Titan "B" was a dismal failure.

These twin disasters have had a slowing-down effect on NASA, which because of its initial successes has been inclined to over-confidence.

Army's Jupiter is doing exceptionally well. The Chrysler-built missile has chalked up a record of seven successes in seven firings.

Army's Redstone, a short-range infantry support missile, graduated from the Canaveral proving ground last year, has since been twice recalled for successful preliminary experiments that will ultimately supply the first astronaut with a taste of outer space. And more such flights are scheduled soon.

Thor-Able has also been tremendously successful in the testing of ICBM nose cones. And this month, the Thor will be used to launch a navigational-aid moonlet.

Those are the ballistic missiles. Other types of U S missiles have been testing out well at Canaveral, too. For instance, there is Boeing's Bomarc, an interceptor missile capable of supersonic speeds. In recent months, the Bomarc's range has been upped to 450 miles, and soon it is expected to exceed 700 miles.

What's ahead at Canaveral? First important new launching will be that of Army's 1.5-million-lb thrust Saturn. Next will come the "Spy in the Sky" camera satellite. And ultimately it will be Canaveral that will launch America's (and we hope the world's) first man in space.

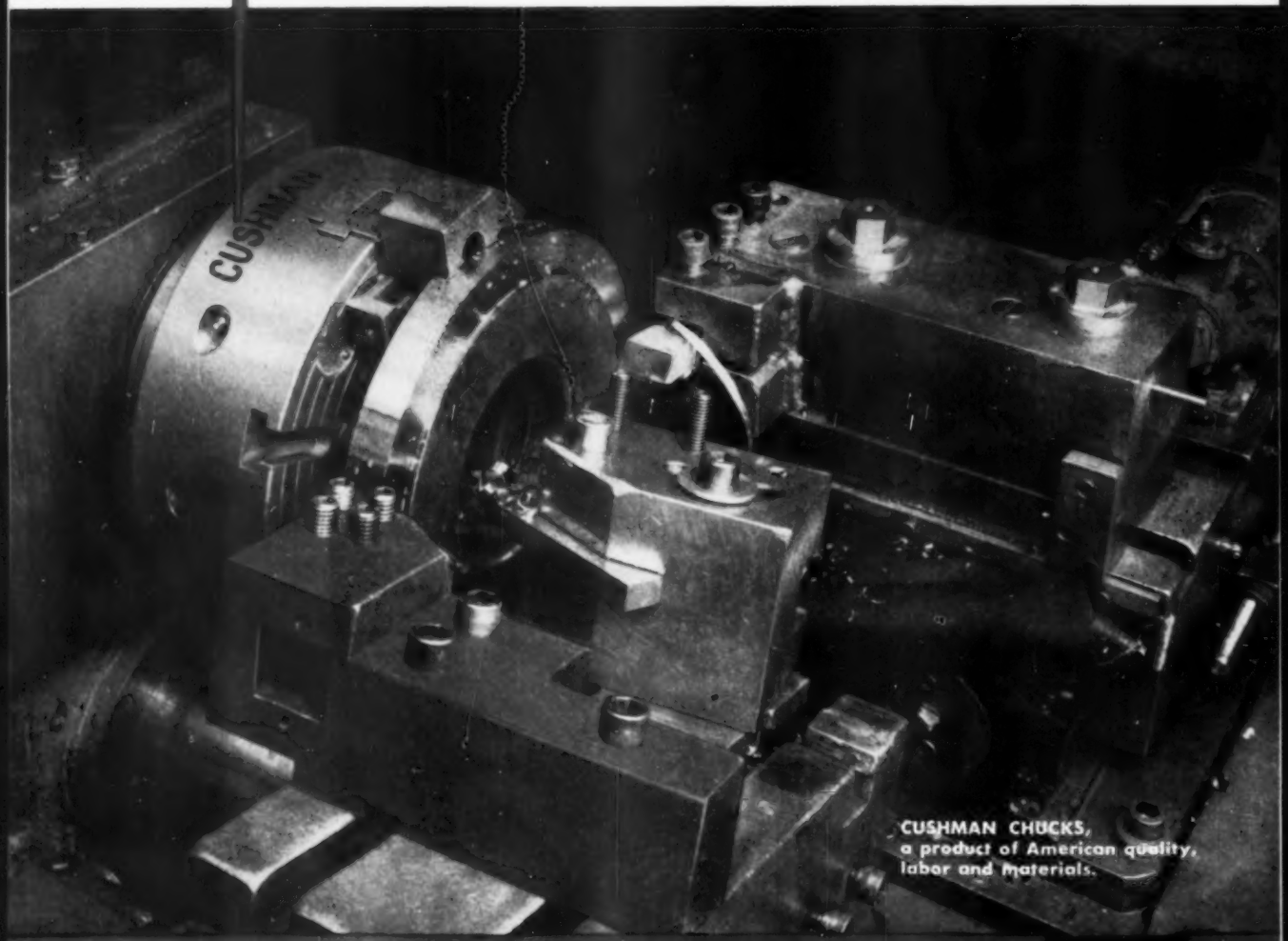
Beat production quotas and costs with:

Cushman air operated

CHUCKING EQUIPMENT

Cushman, the leading manufacturer of air operated chucking equipment, has designed and built a complete line of air operated chucks, cylinders and accessory equipment engineered to meet modern machine tool requirements of heavier feeds at higher speeds, maintain repetitive precision accuracy and positive gripping with truly fast workpiece chucking and unchucking.

Write today for your copy of Bulletin PO-65D and see how you, too, can effectively beat production quotas and lower machining costs by using efficient, economical Cushman Air Operated Chucking Equipment.



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MACHINE TOOLS...

"Production Pearl Harbor"...

Since publishing a report on John Hopkins' study of the Army's machine tool and defense production policies ("Can We Prevent a Production Pearl Harbor? *AM*—July 27 '59 p89), AMERICAN MACHINIST has come in for both bouquets and brickbats.

Sample brickbat: a top Pentagon official's comment to the effect that *AM* shouldn't have published the gist of the report before the Pentagon had a chance to study it.

Sample bouquet: the comment of an industry executive and onetime government procurement expert—"I think that if you had not broken this story, this Study might well have been buried without fully accomplishing its mission . . . Now that it is public knowledge, I am confident it will receive very serious attention."

Serious attention to date: a full column by Sylvia Porter, nationally syndicated newspaper business writer. Reading of the article and Miss Porter's column into the Congressional Record last month by Senator Hart of Michigan.

Everyone believes tool replacement, like motherhood, is a wonderful thing—and the Defense Department is no exception. Trouble is, the Services are stuck with a ceiling on such spending.

Too, the Joint Chiefs of Staff and planners in the individual Services are inclined to give the nod to the end product—bombers, aircraft carriers, and missiles—rather than to the means of making the end product.

Even the Pentagon's industrial production experts admit the only way this situation can be changed is through a massive education program that would teach the military pros about the savings in end-item production that a machine tool modernization program such as that recommended by Johns-Hopkins would effect.

Presumably the Study, which was ordered by the Industrial Preparedness Branch of the Office of the Deputy Chief of Staff of Logistics, is part of a campagin to educate the right Army people.

But there's considerable skepticism within the Pentagon about the worthiness of the Report—parts of which Pentagon says are "fantastic."

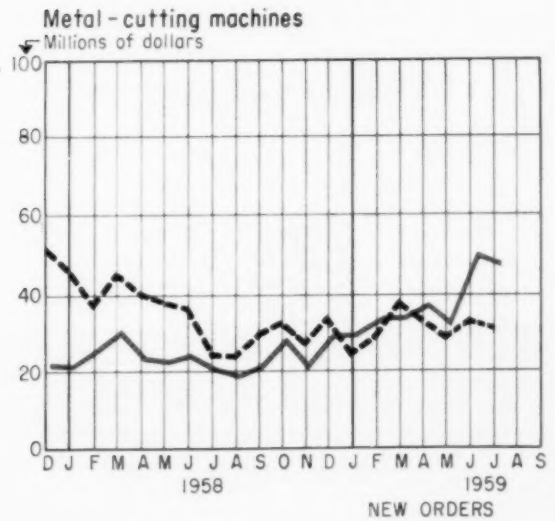
For instance, there's the proposal to buy specific numbers of machine tools (5000 to 6500 a year for the next several years) for an annual cost of around $75 million. Before such a flat estimate can be made, a Pentagon official says, a thorough analysis is needed of end-item requirements and of the savings replacement would effect, "and it hasn't been made yet."

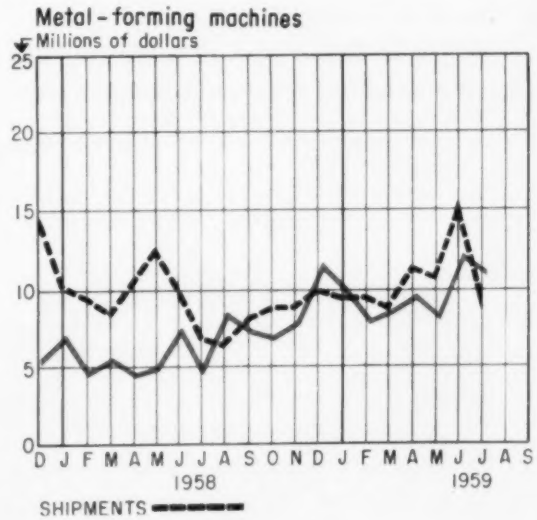
Pentagon also disagrees with the Report's conclusion that tools in Army packages are in bad shape.

Will the Johns Hopkins Study have any effect on Defense Dept replacement policy? "No," says one official, "Everyone around here is running away from it like fleas from a dead dog, and no one admits having had anything to do with it."

But that's the Pentagon's attitude only, and it must be remembered that the report is critical of Pentagon policies.

Others, Senator Hart for one, industrial preparedness planners for another, believe the Report is just the kind of ammunition they need to fight the battle for tool replacement, and thus avoid a possible "Production Pearl Harbor."





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TRENDS

MATERIALS...

Liquid gold...

Use of a gold film on some of the missile and aircraft sections, other than nose cones, that have to be protected from high temperatures has been under test for 18 months. Gold was found unequalled as a reflector of infra-red radiation, according to R T Hopper, v p of Englehard Industries, Inc and head of its Hanovia Liquid Gold Div.

Liquid gold solutions are sprayed or "painted" on vulnerable surfaces and, after baking, a metallic film 0.000,004 in. thick is left on the surface. This abrasion resistant film is an efficient reflector of infra-red radiation and reduces the rate of heat transfer on engine shrouds, drag-chute containers, tailcone assemblies and blast shields. The metallic film permits the use of light structural materials. Its own weight is negligible.

Rolled zinc alloys...

New zinc alloys developed by The New Jersey Zinc Co, after ten years of research, are said to possess far greater resistance to creep and grain growth as well as have a substantially lower coefficient of linear expansion than any other zinc alloy in strip or sheet form produced to date.

A typical alloy containing 0.8% copper, 0.15% titanium and the balance pure zinc can be rolled to provide a creep rate of more than 5000 days per percent elongation under a load of 10,000 psi at 25C. This means a change in length of only 1% in 13.5 years for a test specimen under a constant tension of 10,000 psi. Another outstanding property claimed for the new alloys is resistance to grain growth during annealing. This ability is valuable where high temperature cycles are involved, such as in japanning and lacquering.

As a replacement for more expensive non-ferrous metals for structural and ornamental parts, these Zilloy alloys, which also have good drawing, forming and plating characteristics, are expected to have a substantial market. Other rolling mills have been licensed to produce these patented alloys.

License special stainless production

Production "know-how" for the precipitation hardening, stainless-steel alloys, AM 350 and AM 355, is being shared by Allegheny Ludlum Steel Corp with a group of four stainless and specialty steel producers. Licenses were granted to Carpenter Steel Co, Crucible Steel Co of America, Universal-Cyclops Steel Corp and Vanadium Alloy Steel Co. The reason, according to Clark W King, executive v p of Allegheny Ludlum, is the company's recognition of the need to create alternate sources of metals vital to defense and to advance commercial technology.

Production techniques necessary to manufacture bar, sheet and other wrought forms were described at a one-day seminar in Pittsburgh. Research officials and metallurgists of the licensee companies attended the conference.

Oils from "impossible" compound...

Sulfur tetrafluoride is a reactive gas which, unlike other reagents, possesses the ability to replace oxygen with fluorine in many chemical compounds. It opens the way to compounding a large number of fluorinated products heretofore unavailable.

Uses of the material might be in production of improved weather-resistant finishes, and oils, films, plastics, and elastomers with high thermal stability and resistance to oxidation. The low surface energy characteristic of many fluorinated compounds also suggests use of sulfur tetrafluoride in producing surface-active agents, water and oil repellents, and lubricants. Major use of the gas, developed by the DuPont Central Research Department, is expected to be in creating a new line of high potency pharmaceutical products.

Slippers and whitewash...

When the high-speed (over 1800 mph) rocket sleds make their hasty six-to-seven mile runs, friction between the slippers, which hold the sled on the rails, and the rails is a serious problem.

Temperatures generated sometimes exceed the melting points of the high-temperature metals. Stanford Research Institute's Physics Dept studied ways to prevent undue slipper wear. Best materials so far are molybdenum or vanadium for the slipper and a film of zinc or calcium hydroxide (whitewash) on the rails. Molybdenum must wait, however, until a more ductile alloy can be developed.

Molybdenum experienced the least wear on the high-speed runs but, because of its brittleness, the slippers broke in 30% of the runs. At present, SRI's metallurgy department is attempting to produce a more ductile molybdenum alloy. If the alloy is found, it should have application to a variety of other high-speed bearing problems. Work is being done under a contract from the Air Force Missile Development Center, Holloman AFB, New Mexico.

Cuts assembly time in half with...

NEW ROTOR J-40S IMPACT WRENCH

JOB: Driving ⅜" bolts to attach cover and insulators on distribution transformers. Formerly used ratchet hand wrench . . . fatiguing to the operator . . . a bottleneck.

RESULTS: New Rotor J-40S Air-Powered Impact Wrench (with special extension drive to clear insulators) does the work in less than half of former time. Bolt tightness is uniform. Operator fatigue is eliminated.

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ROTOR TOOLS
CLEVELAND, OHIO

WHAT'S AHEAD... in Metalworking

TRENDS

Metalworking is feeling the steel pinch...

Metalworking production is still trying to get back to the record high achieved in June, but its climb is hampered by strike-caused shortages of steel. To be sure, not every plant nor every industry is feeling the shortage enough to slow down production substantially.

But there are still enough companies around that are feeling the steel pinch enough to affect the overall metalworking production picture.

Oddly enough, however, steel warehouses in the nation's metalworking centers report that total steel inventories in warehouses across the country are at the 3,125,000 ton level, compared with 3,700,000 tons at the start of the steel strike, and a good 20% higher than they were at the beginning of the 1956 steel strike.

One reason why metalworking plants haven't made great inroads into warehousers' supplies is that the strike came along just about the time many user plants went on vacation.

In shortest supply at the moment are plate, hot-rolled bars, cold-rolled bars, flat-rolled products and high-strength alloy plate.

Orders for aircraft parts are on a descending spiral, aggravated by the government's recent abrupt cut off of such projects as the B70 bomber. No improvement is seen for the rest of the year, despite an increase in orders for parts for commercial jets and other civilian aircraft.

Auto parts manufacturing outlook, on the other hand, is excellent. Orders have held up well all through the usually slow summer months, are expected to pick up rapidly as the U S compact cars make their debut this fall.

Screw machine products manufacturers have just racked up the biggest peacetime six months in their history, equalling shipments of 1953 (Korea). New orders are picking up as much as 10% month by month, are running 69% ahead of mid-1958.

Tool and die manufacturers, too, report a month by month increase in volume of new orders and shipments, reversing a slight downtrend a few months back. Backlogs are up anywhere from 25 to 50% over year-ago levels, and employment is increasing steadily.

Tool and die industry officials consider the outlook for the next few months as anywhere from good to excellent. Tool steel inventories continue plentiful in shops.

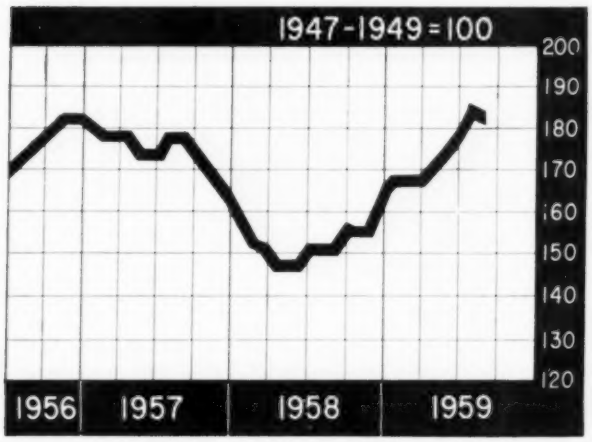
Makers of heating and plumbing equipment, on the other hand, say business is up only slightly from recession levels. However, they are optimistic over prospects for the rest of the year—and 1959 business should be ahead of 1958's.

Outlook for the electronics industry is good, to say the least. With few exceptions, these firms are doing substantially better business than they did a year ago.

Missiles are still the driving force behind the electronics industry, particularly on the West Coast, "peace scare" notwithstanding.

However, commercial and industrial electronics is the really growing field—from $646 million in 1950, to nearly $2.5 billion this year, and it's expected commercial and industrial electronics will be a $6 billion business by 1970.

The military electronics dollar this year is expected to run to $4,475,000,000 and by 1970 this should reach $9-$10 billion.



AMERICAN MACHINIST INDEX OF METALWORKING PRODUCTION

BASED ON MANHOURS WORKED IN THE FIVE COMPONENTS

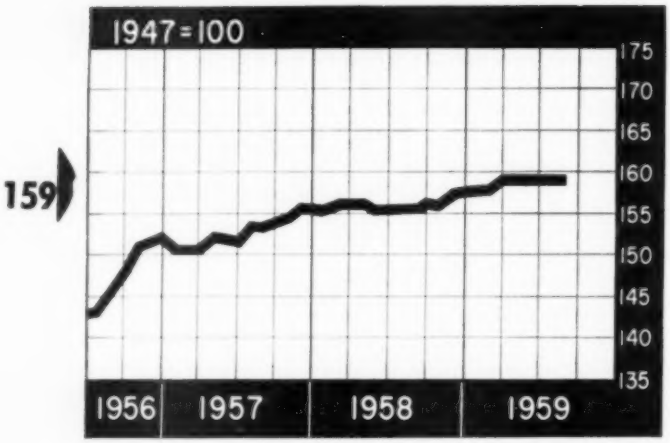
	AUG Estimated	JULY Preliminary	JUNE Revised	JULY Year Ago
Total Index	**183**	**185**	**183**	**178**
Machinery	155	154	126
Electrical Machinery	220	218	181
Autos	141	139	84
Other Transportation	351	351	333
Other Metalworking	159	158	135

TRENDS

WHAT'S AHEAD... in Business

AMERICAN MACHINIST INDEX OF METALWORKING PRICES

	AUG Estimated	JULY Preliminary	JUNE Revised	JULY Year Ago
Total Index	**159.0**	**158.8**	**158.7**	**155.8**
Metalworking Machinery	... 185.6	185.3		181.2
Other Machinery exc. Electrical	169.8	169.7		166
Electrical Machinery	... 160.2	160.0		158.9
Fabricated Metal Products	..... 148.8	148.8		133.1



The industrial economy dips–temporarily...

Industrial production during July took its first dip since April of last year, as output fell from June's record high.

The drop in production can be attributed solely to the slowdown in steel output caused by the prolonged steel strike, because the overall level of business activity is continuing to rise.

It is now a fairly good bet that the Gross National Product (total value of all goods and services produced in the U S) will hit the $500 billion annual rate mark in the final quarter of this year.

Continued high expenditures by all levels of government will be an important factor in business activity for the remainder of the year. Defense spending alone will hit an annual rate close to $47 billion during fourth quarter 1959.

State and local governments, too, will be spending increasing amounts for schools, highways and similar projects in the months ahead.

Total spending by these government bodies will be over $45 billion in the closing quarter of the year—$3 billion higher than it was during the corresponding period in 1958.

Business capital spending also will be growing. Manufacturers will be buying capital equipment at a rate in excess of $27 billion in the final quarter of this year.

Spending for new plant will increase, too, but inventory building is certain to be below this year's second quarter rate. Thus the overall level of business spending is likely to drop, even though capital spending is on the rise.

Steady growth in consumer spending will be more than enough to offset the decline in overall business spending. Sales of automobiles and other durables will show steady improvement.

Preliminary estimates from Detroit indicate that 1960 will be the best auto sales year since 1955. Consumer spending will end the year 1959 something like $20 billion ahead of 1958's rate.

WEEKLY BUSINESS INDICATORS

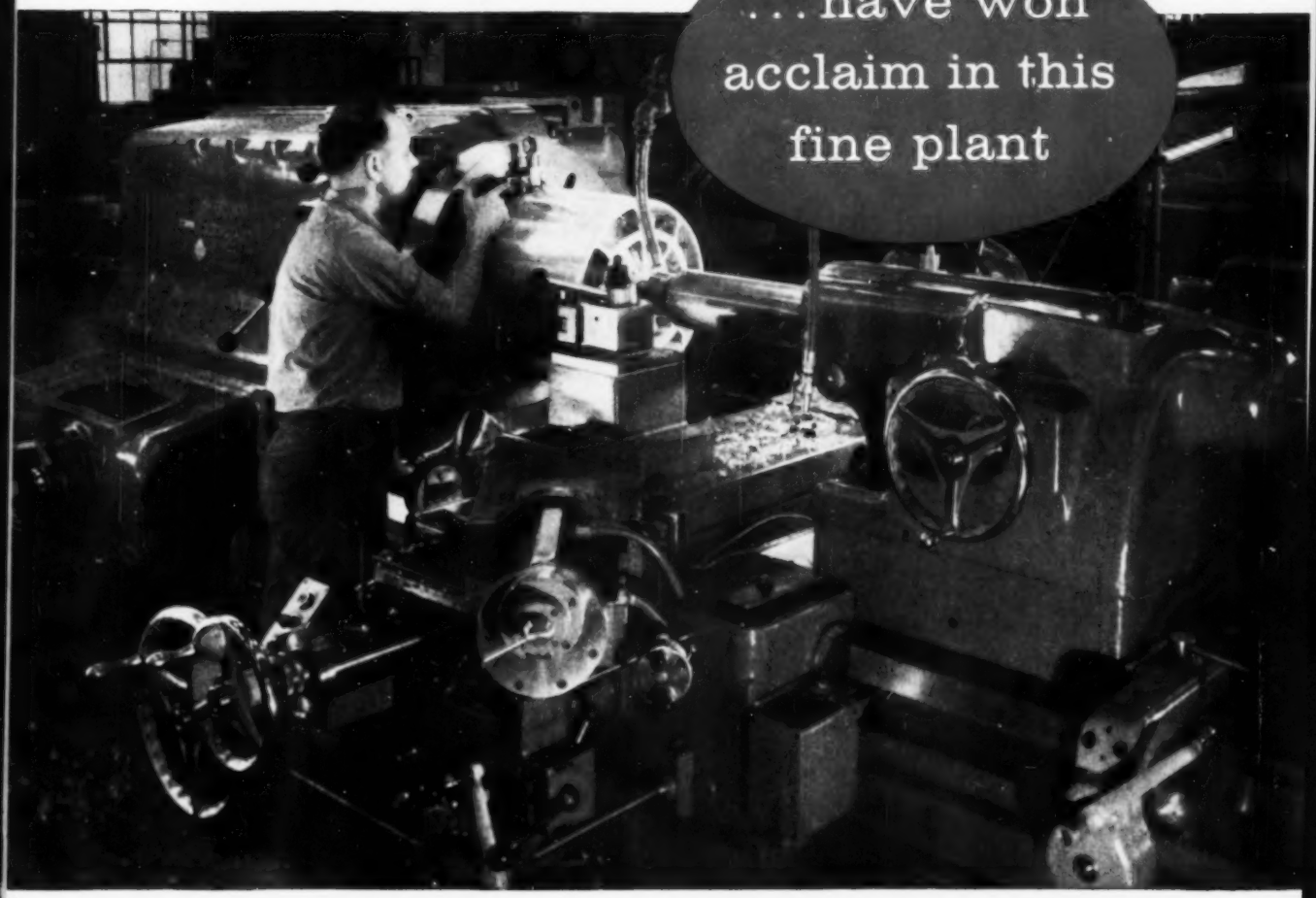
	Latest Week	Preceding Week	Year Ago
Business Week Index of Activity (1947-1949=100)*	151.0	151.6	133.1
Steel ingot operation (thousands of tons)	343	321	1,715
Electric power output (million Kilowatt hours)	14,003	13,648	12,486
Production of automobiles and trucks	51,373	84,086	38,096
Engineering construction awards (Eng. News-Record, millions)	$ 293.0	$ 377.9	$ 397.8

MONTHLY BUSINESS INDICATORS

	Latest Month	Preceding Month	Year Ago
Index of industrial production (1947-1949=100)*	153	155	134
Index of durable manufactures production (1947-1949=100)*	169	172	141
Durable goods manufacturers' sales, millions*	$15,766	$15,515	$12,086
Machinery manufacturers' sales, millions*	$ 4,552	$ 4,507	$ 3,780
Durable goods manufacturers' new orders, millions	$15,849	$15,241	$12,245
Machinery manufacturers' new orders, millions	$ 4,812	$ 4,626	$ 3,592
New Orders for Nonelectrical Machinery (1950=100)*	190	173	163
New Contracts for Industrial Construction (1950=100)*	141	142	89

* Seasonally adjusted

"American" TRACER LATHES



Bulletin
No. 135

gives a complete description and shows many examples. It's yours for the asking.

The Mechanical Division of General Mills, Inc. in Minneapolis, Minnesota uses "AMERICAN" Tracer Lathes for their contouring work. 17 years of ordnance and instrument work have conclusively demonstrated to the General Mills officials that only the highest quality equipment can produce the precision work that their contracts require—result "AMERICAN" selection.

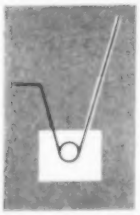
More production per man hour is the answer and only answer to spiraling costs—modern, high production machinery is the answer to greater production per man hour. Judging from reports, the Mechanical Division of General Mills, Inc. has found this to be true.

THE AMERICAN TOOL WORKS CO. Cincinnati 2, Ohio, U. S. A.

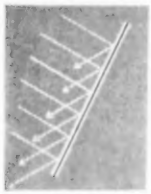
CIRCLE 244 READER SERVICE CARD

LATHES AND RADIAL DRILLS

ARMCO
ALUMINIZED STEEL
TYPE 1



Sturdy steel coated with aluminum by a patented hot-dip process. No metal of comparable price can match ALUMINIZED STEEL Type 1 in resistance to destructive combinations of heat and corrosion.



The surface of this aluminum-coated steel reflects up to 80 per cent of radiant heat. It's used to "save" heat (hold it in) or to direct heat where it's wanted.

ALUMINIZED STEEL will withstand moderate forming, drawing or spinning operations without flaking or peeling

of the coating. Costs stay low because ALUMINIZED STEEL needs no further finishing after fabrication. Twenty years' experience by hundreds of manufacturers shows that products and parts made of ALUMINIZED STEEL mean service savings too—through longer life, more efficient operation.

For information about this aluminum-coated steel originated by Armco, write: Armco Steel Corporation, 2469 Curtis Street, Middletown, Ohio.

New steels are born at Armco

ARMCO STEEL

Armco Division • Sheffield Division • The National Supply Company • Armco Drainage & Metal Products, Inc. • The Armco International Corporation • Union Wire Rope Corporation • Southwest Steel Products

American Machinist

THE MAGAZINE OF METALWORKING MANUFACTURING • ESTABLISHED 1877

The Price Must Be Right

John Q Public is watchful of his money. He loads up at the supermarket where he thinks that he gets the most for his dollar. If he wants a major appliance, he is apt to head for the nearest discount house.

He has been buying small European cars because he gets them for less and they run a lot of miles on a gallon of gas. He is not too concerned, in fact, about whether what he buys is made here or abroad.

The latest polls show . . .
that, if anything, he is more price conscious than ever. He is scared about inflation. If the price of what he wants is too high, he is inclined to stop buying.

His concern about prices is no greater than that of every alert manufacturer of metal products. The manufacturer, in a broad way, may view inflation as inevitable as death and taxes. But in his own business he intends to do everything possible to postpone the evil day.

In the war on inflation, high costs are the enemy. High costs contribute to high prices. And the customer is allergic to high prices. Prices therefore must be kept down.

This critical area of costs . . .
was the subject of a recent talk by E S Wellock, manager of manufacturing plants of Chevrolet, before the Drop Forging Association. He observed that exceptional quality is only half of the requirement for a successful product. The second and more important half is cost. It is relatively simple to make a product, he said. The challenge is to make it better for less cost.

Mr Wellock bluntly stated that many of the small forge shops that he has visited have changed their equipment and processes little in the past ten to thirty years. Outdated machinery is in use. As long as this situation exists, prices of forgings will necessarily follow the standard inflation curve.

A sound replacement and modernization program can help counteract this curve and put the forge shop's product in a better competitive position, he declared. Such a program should be financed by setting aside a certain necessary portion of earnings.

These wise and pertinent observations are applicable throughout metalworking and not to the drop forging industry alone. Never has competition of one process against another been so strong — forgings against castings, castings against stampings, aluminum against steel, metal-cutting against chipless machining, one metal-cutting process against another. Pressures to hold down costs are tremendous.

The same relentless competition . . .
exists between one maker of cars and another, one TV set builder and another, one refrigerator company and another. And John Q Public is taking a microscopic look at the price tags on the final products.

In this competitive hurly-burly, you can be sure of one thing, or success will elude you: the price must be right.

At this point, Mr. Wellock's theme takes on its full significance. You can't keep up with the competitive times making your product, whatever it is, with obsolete machinery and by antiquated methods. If your business is to grow or even stay at its present size, you must not let high costs take over. Best preventive is sound and continuing modernization and replacement.

Burnham Finney EDITOR

ARE YOU READY WITH THE ANSWERS

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MAKES THE BEST PRODUCT BETTER

Threadwell Field Men and Distributors Can Help You in Production Planning

When your next order involves multiple or complicated machining operations, and you've got your processing and production equipment all lined up, make sure you insure your investment by putting Threadwell cutting tools in those holders. They'll provide the uninterrupted high quality production all your machine tools are designed for.

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800 machine tools go on the block at Fairchild-Deer Park as . . .

AM goes to an auction

"$2800, $3000, $3200, $3300—are you done, are you through? SOLD!" Five hundred or so private buyers and dealers jotted down the bid in their catalogs, edged forward as the auctioneer moved on to the next machine: "Lot number 2181. A No. 3A Lodge & Shipley Duomatic lathe, 24 speeds. What am I bid?"

So it went for three full days. Hoarse auctioneers spelled each other at hour intervals: "Lot number 2199. Warner & Swasey universal turret lathe. What am I bid?" Some of the crowd left, others came in, some wandered around the huge room, inspecting machines that would come up for auction later.

Yesterday: broaches, profilers and gear cutters. Today: screw machines, engine and turret lathes, drill presses, millers. Tomorrow: grinders, shapers, radials, jig mills, presses.

And everywhere dealers and buyers feverishly jotting down bids—for this was an auction to remember—nearly 800 machine tools going under the auctioneer's hammer, resale value around $4 million, original cost $16 million. And along with machine tools, hundreds of thousands of dollars worth of tooling, laboratory equipment, office furniture and machines, welding and inspection equipment, even passenger cars, trucks and tractors. This auction could well be a used machine tool price-setter for months to come.

This was the end of Deer Park, Fairchild Engine & Airplane Corp's huge (490,000 sq ft), modern (built in 1953), completely equipped ($8 million worth of Fairchild-bought machines, $8 million worth of government-bought machines) Long Island engine facility.

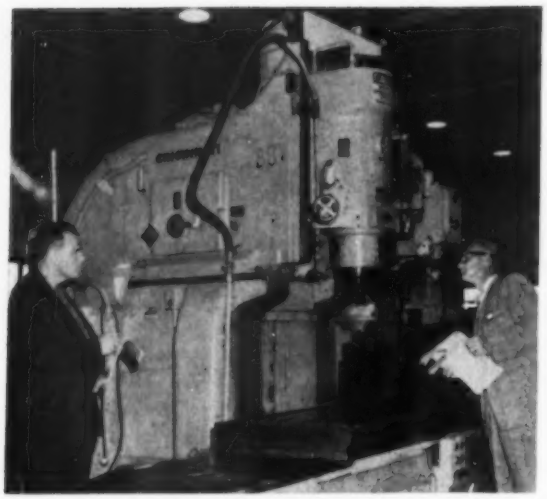
Everything must go in five jam-packed auction days, from micrometers to broaches, from typewriters to Borematics, from fork lift trucks to vertical mills. And by September 1, even the plant and 100 of its 300 acres would go, bought for $4.5 million by Airborne Instruments Corp, which would consolidate its 17 separate Long Island operations into giant Deer Park.

"Can't match these bids and make a profit—too many direct buyers here," the time-honored complaint of the used machinery dealer. The bids *were* high, and with good reason. Almost without exception the machines were U S-made standards, clean as a whistle. Almost any shop could use them to advantage, and bidders were here from all over the country, plus some from Canada. On hand, too, was a representative of Israel's Ministry of Defense, here to pick up jet engine test equipment. By auction time, mailed bids were pouring in from all over.

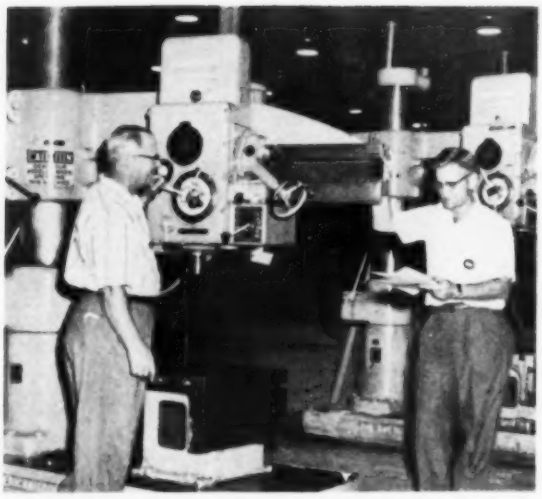
Some prospective buyers had been around for several days poking, probing, inspecting, peering into machines by the light of a match looking for serial numbers.

One of them, Nat Quinn of Philip-North Inc, used machinery brokers, commuted in several times from nearby Farmingdale, L I, was impressed, "Best equipment I've ever seen at any sale. Maybe somebody else has seen better somewhere but I haven't. I'd say the average age of the machines here is five years. This is going to be a *very* expensive auction, and you can quote me on that."

Another early bird on hand to



Looking over a Cincinnati Hydrotel before the auction were (left) W H Rogers, owner, Automatic Screw Machine Tool & Supply Co, Detroit, and H W Nickerson, Eastern District sales manager (New Jersey), Fellows Gear Shaper Co



Dealers on hand checking the serial number of an American Hole Wizard just before it was auctioned off were (left) Samuel Green and Howard Green of Green Brothers of Worcester, Mass. Another Green—Arnold—had been in the week before to check, too

make sure he wouldn't get a pig in a poke was Adolph Kalberer, president of Industrial Tool & Machine Co, Georgiaville, R I, contract tool and die shop:

"I've got my eye on a Pratt & Whitney jig borer. I expect it'll go high but maybe not too many people will be interested in it and I might get a good buy. I know used machine prices are pretty high these days, but if you keep your eyes open you can get a good price sometimes."

(Editor's note: The auction people say that the Liberty Products Corp sale at Farmingdale, L I, last October marked an upturn in used machine tool prices. Bids at that auction jumped 25% over those during the recession, and prices have stayed that way since).

A used machinery dealer, Arnold Green of Green Brothers of Worcester, Mass, was on hand early, too: "It pays to look any auction machine over in advance, otherwise all you've got to go on is appearance. There's lots of good standard stuff here and it's all clean. Any dealer can move it fast. I'm here to buy for stock, and you've really got to watch prices when you do that."

Dealer, buyer for a small shop, buyer for a big shop—there was something for everybody at the Deer Park sale. One of the biggest attractions was the hundreds of thousands of dollars worth of tooling—most of it in perfect condition, some of it never used: hundreds of taps, chucks, cutters, reamers, etc.

There were micrometers, gage blocks, hand tools, gages of all kinds, factory and mill supplies, surface plates. There was everything for metallurgical and electronic labs from microscopes and ultrasonic standard blocks to lab furnaces and electro photometers.

There was engine test cell equipment, furnaces and shotblast equipment for heat treating, sheet metal machinery, saws, seven aluminum melting furnaces, even woodworking machinery. Most of this equipment went on August 24 and 28, the first and last days of the sale, along with trucks and passenger cars, office machines and furniture.

But the heart of the sale, August 25-26-27, was reserved for the star attractions—machine tools.

On sale, for example, were 133 grinders — cylindrical, crankshaft, surface, centerless, tool and cutter, contour profile, internal, opposed disk and thread grinders.

Then there were the milling machines, dozens of them—Cincinnatis, K & T's, Van Normans, Milwaukees Gortons, Halls, Bridgeports, Pratt & Whitneys.

Lathes were everywhere—Lodge & Shipleys, Hendeys, Dimcos, South Bends, Monarchs, Sidneys, Hardinges. And there were turret lathes: Warner & Swaseys, Gisholts, J & L's, Fays, among others.

Up for auction by the dozens, too, were radial and multiple spindle drills, drillpresses, big broaches, kellering machines, gear cutters and shapers.

"This isn't the biggest sale we've ever handled dollarwise, but it's one of the biggest," Jesse Thaler, vice president of Industrial Plants Corp, auctioneers handling the Deer Park sale, told AM reporters, "and this sale is really unusual. The machines are almost all top quality U S makes, and they're all standard. Almost any shop can use this stuff. Just look around and see how well this shop has been kept up, and the machines are that way, too. You just can't beat the Fairchild people when it comes to maintenance.

"I'd say the machines here date from 1942 to 1958, and a lot of them are *very* little used. In fact, some of them came in after the Fairchild contract cancellations, and it's pretty certain they weren't used at all in production."

And that's one reason, according to Thaler, why mailed bids started to pour in as soon as the notices went out. It is the reason, too, why some of the country's most important metalworking firms had men on hand when the plant opened for inspection a week before the sale. "That many big companies is unusual, but this is unusual equipment."

Pre-auction attendance began to snowball along about the middle of the week of August 17. By Friday preceding the auction, several hundred prospective buyers were on hand, carefully examining machines and equipment, checking serial numbers for age.

First to arrive, and they returned again and again, were men from aircraft and metalworking plants in

the area. Later in the week, representatives of plants as far away as the West Coast arrived, filling hotels and motels for miles around.

Thaler claims that about 90 plant buyers show up at auctions today for every 10 dealers; that machine tools today go for anywhere from 15% of original cost (old specials in bad shape) to around 85% of new machine prices for late-model, top-grade standard machines.

Most of the machines auctioned at Deer Park fell into the latter category, and even older models on the block brought premium prices because of the excellent care Fairchild had taken of them. Aside from the nearly 800 machine tools on sale, some 400 Air Force-owned machines were on the auction floor, pink-tagged for shipment and not for sale. According to several visitors interested in them, the Air Force had many of the machines earmarked for the government's "Tools for Schools" program.

Even before the auction ended, teams of riggers were at work dismantling, skidding and readying the hundreds of machines for shipment by truck and rail. There were surprisingly few riggers for a job of this size, less than half a dozen crews of 5 men each, but the concessionaire, Manhattan Rigging & Trucking, was thoroughly familiar with the machines, having moved many of them in when the plant opened back in 1953. In all, the Manhattan people figured they would have the giant plant cleared to the wall in 10 days.

Ghost plant—for a while

Then Deer Park would be a ghost plant. The huge manufacturing halls where nearly 3000 people once worked would be empty and silent except for the occasional footfalls of watchmen.

The nearby town of Deer Park would be a ghost town, too, dotted with "For Sale" signs on homes of Fairchild workers moving out—people who had hitched their wagons to a guided missile that never got off the ground.

But Deer Park won't stay a ghost plant in a ghost town for long. Airborne Instruments is already beginning to move in, with 8000 workers from its 17 plants, instead of Fairchild's 2800 or so, the "For Sale" signs will come down as Airborne's employees look for homes near their work . . . it looks like once-ill-starred Deer Park's luck will change for the better.

HERE IS HOW THE BIDDING WENT AT FAIRCHILD-DEER PARK

No. 3B Pratt & Whitney jig borer $16,000
14 x 54 in. Monarch lathe (1941) $4200
16 x 54 in. Monarch lathe (1941) $4300
20-in. Rockford shaper $3100
14 x 66 in. Hendey lathe $2750
24-in. Cincinnati drillpress $2000
No. 3 Brown & Sharpe universal grinder $3200
No. 2H Kearney & Trecker plain miller $3000
Cincinnati Hydrotel $12,000
No. 2 Cincinnati vertical milling machine (1940) $5250
12 x 36 in. Cincinnati grinder (1938) $1500
No. 3L Gordon pantograph machine $4500
16-in. Gould & Eberhardt shaper $3250
20-in. Cincinnati shaper $3250
No. 18 Blanchard surface grinder $8000
Crystal Lake toolmaker's grinder $1400
13 x 40 in. Dimco (Italian) lathe $1600
6 x 36 in. Jones & Lamson thread grinder $7000
10 x 48 in. Cincinnati cylindrical grinder $2000
No. 2A Pratt & Whitney jig borer $9000
42-in. Bullard CutMaster vertical turret lathe $27,500
16 x 84 in. Sidney lathe (1952) $7700
No. 5 Warner & Swasey turret lathe $4100
No. 4 Warner & Swasey turret lathe $4800
No. 7B Jones & Lamson turret lathe $9000
No. 2G Brown & Sharpe automatic screw machine (1941) $5000
No. OG Brown & Sharpe automatic screw machine (1941) $4100
No. 3H Kearney & Trecker milling machine (early 1940's) $4500
Sykes (English) gear hobber $4600
10 x 40-in. Thompson surface grinder (early 1940's) $4600
No. 3 Cincinnati vertical milling machine (1941) $5200
Model 3620 Pratt & Whitney kellering machine $9000

(Editor's note: Where possible, year of purchase of the machine is given. Prices were taken down as American Machinist went to press, and condition of the machines could not be given. Machines as a whole, however, were in good condition, varying in age from 1940 to 1958 (but none of the 1958 machines are listed here). Prices shown are the actual bids for the machine as-is on the floor, do not include costs of dismantling, removal and shipment to the bidder's plant.)

A comprehensive listing of the machine tools auctioned at Fairchild-Deer Park and the prices they brought will be sent free—limit one to a subscriber—to readers. Write Reader Service, American Machinist, 330 W 42nd Street, New York 36

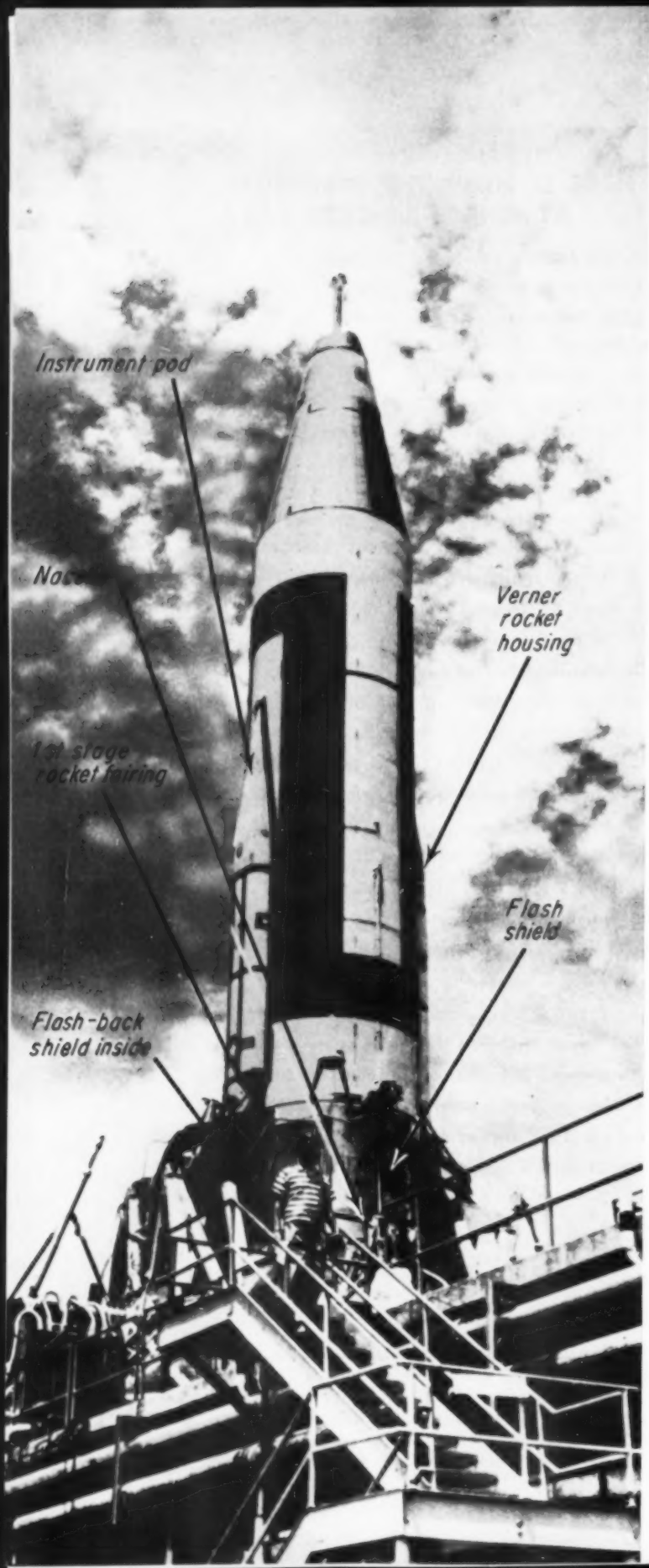
Will heat-

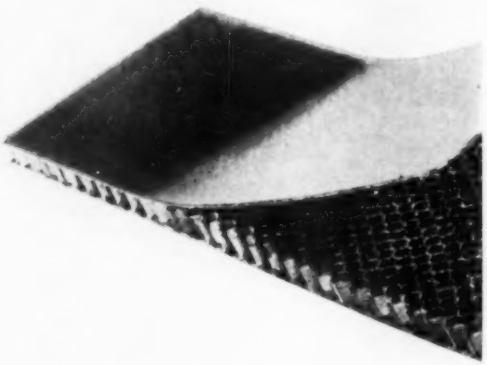
By Harry Raech, Jr,
materials research engineer,
Norair div,
Northrop Corp, Hawthorne, Calif

The aircraft-missile industry is dumping "kitchen-stove methods" and depending on precision techniques for forming plastics. Because there are now reinforced plastics available with useful properties at 1000 F and higher for prolonged periods, these materials are receiving tool-engineering attention that takes them out of the "quick-and-ditry" category.

One special advantage of plastics is illustrated by a space vehicle under study at Northrup. The pilot's compartment—72 cu ft—is calculated to require 1.1 million BTU/hr of refrigerating capacity at 40,000 ft altitude to counteract friction heat. This figure is for 1-in. brazed stainless-steel honeycomb sandwich construction. But a plastic sandwich of equal thickness only requires 1/10 the refrigerating capacity. Reason: the plastic has 1/10 the thermal conductivity.

Up-to-date plastic materials also have a high strength/weight ratio. Already nearly 20% of each Atlas missile is reinforced plastics and plastic sandwich. The first-stage nacelle, 6 ft long and 10 ft across, is sandwich construction with a phenolic-fiberglass skin. The flashback shield, which prevents rocket blast from reverberating back around the rocket motors, is a silicone sandwich $1\frac{1}{2}$ in. thick and 10 ft in diameter. Two instrument pods are silicone laminates, and the vernier-rocket





Plastic honeycomb sandwich . . .
is applied in Convair's Atlas, where smooth aerodynamic surfaces and low assembly cost are advantages. Compared to steel, plastics have superior strength-to-weight ratios, lower thermal conductivity, and higher fatigue resistance

resistant plastics replace steel?

They look good in aircraft and missiles, where plastic sandwich construction offers good strength at high temperatures. New materials and better fabricating techniques will help spread applications

fairing and the large vernier-rocket flash shield are phenolic-glass laminates.

Among subsonic vehicles, the Northrup RP-70 drone is all fiberglass-reinforced construction except for the rocket motor. Tail sections are fiberglass-phenolic honeycomb core bonded to 0.03-in. fiberglass-cloth-reinforced epoxy faced with epoxy adhesive. Conical forward and aft elements of the fuselage are autoclave-bonded polyester reinforced with glass cloth. The wings are 0.07-in. polyester skins epoxy-bonded to paper honeycomb cores.

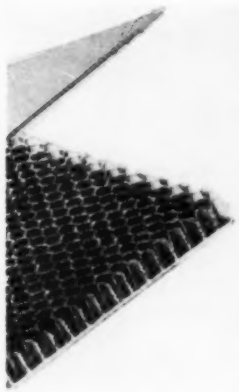
New Plastics

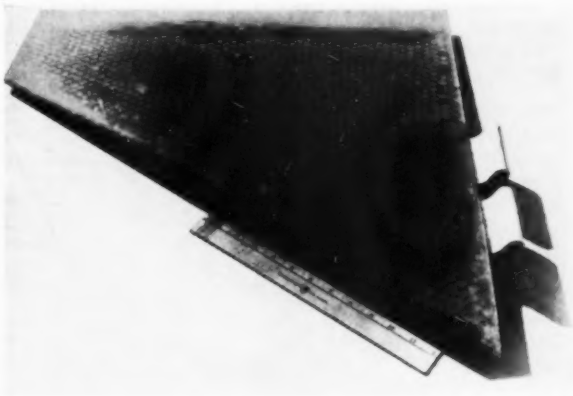
A number of new plastic laminate and sandwich materials for application at temperatures above 500 F are being studied at Northrup. Refrasil-modified phenolic sandwich panels, for example, have been subjected to 2000 F for a half hour with only negligible breakdown of physical properties. This material is an inorganic plastic that can be fabricated like a phenolic laminating resin. It is brittle, and it is not strong compared with ordinary plastic laminates at ambient temperatures; but it is capable of high temperature resistance with little reduction in strength.

Refrasil is composed of synthetic silica fibers, which are inherently weak because of chemical processing, but which have a high melting point (3000 F). Honeycombs have been made with ¼-in. strips of the material brushed with a resin coating. Face plies of the laminate have been simultaneously post-cured and bonded to the core materials. The cure cycle requires 35 psi (for bonding) at 325 F for 30 minutes. Sandwich assemblies have been cured in an autoclave inside a vacuum bag with external positive pressure. A post-cure cycle, with the bag still under vacuum, requires a cold oven heated to 350 F for 24 hr, then 375 F for 9 hr, 425 F for 15 hr, and 475 F for 9 hr. After post curing, the sandwich panels are fired in a heat-treating furnace at 1500 F for five minutes.

Another promising material is a silicone-fiberglass sandwich with an asbestos honeycomb core, which is applied in temperatures under 800 F. Silicone-laminate faces are made by press-molding four plies of pre-impregnated material at 100 psi and 325 F for 30 minutes. Post curing requires an uninterrupted sequence of 200 F for 16 hr, 260 F for 2 hr, 300 F for 2 hr, 350 F for 2 hr, 410 F for 2 hr, and 480 F for 48 hours.

The silicone-honeycomb core is bonded to the face ply by roller-coating the matching surfaces and letting them air dry for 15 min, then mating the surfaces and placing the parts in a PVA bag under vacuum for 30 minutes. After removal from the bag, the assembly is kept under 9 psi for 72 hr. Post curing is identical to that for the phenolic





Paper honeycomb in a wing . . . holds up to fatigue stresses better than forged aluminum hinges that hold the wing to the fuselage of Northrup's RP-70 drone. Visible pattern indicates excellent bond

Plastic blast-tube liner . . . connects a rocket motor to a rocket nozzle, to pass gas flame at 4300 F and velocity of Mach 0.99. Wall, 0.43 in. thick before firing, was reduced to 0.378 in. at inlet and 0.391 at outlet with a uniform taper between after 40 seconds of firing. Tube OD reached only 1200 F after stabilization

Glass-phenolic rocket nozzle . . .
is made by a new technique; filament winding of phenolic is bound to fiberglass. A porous metal liner lets liquid fuel seep through so heat of vaporization cools the nozzle

sandwich except that a vacuum is applied for the first 8 hr.

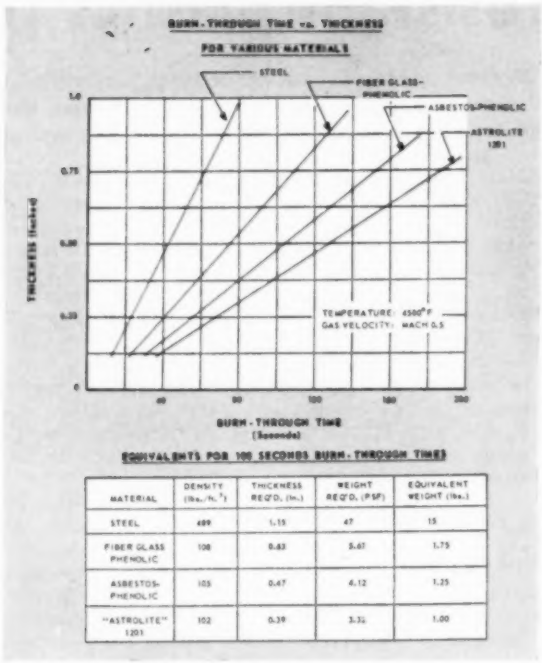
Tests showed lower strength than expected, but improved adhesives and bonding techniques are under development. The laminate cure may be combined in the future with honeycomb bonding to increase the sandwich strength.

Face ply laminates have also been made of a phenyl-silicone material that will bond to phenolic glass and phenolic asbestos cores. One laminate ply is peeled, and a ply of pre-impregnated material is added. Bonding cure cycle is 100 psi at 325 F for 45 minutes.

Test results

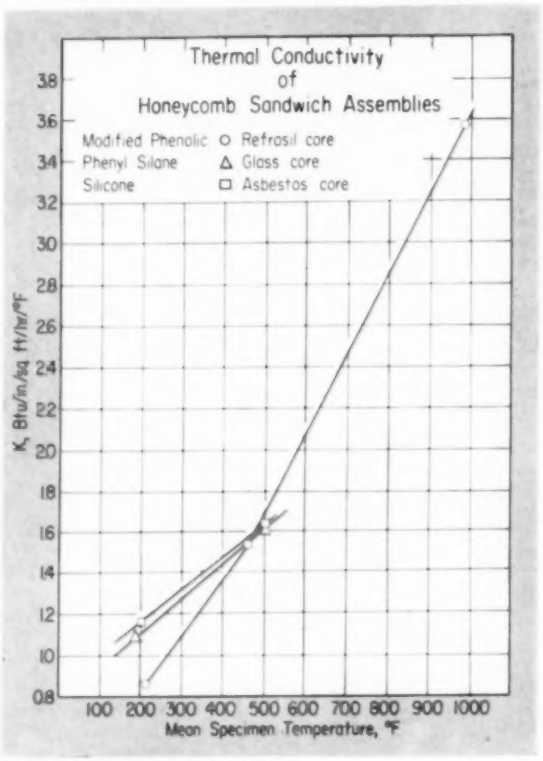
After post curing, the panels have been tested for thermal conductivity. Then the sandwich panels were given beam-shear and compression tests. The refrasil core showed beam-shear strength of 135 psi after a half hour at 1000 F. Under the same conditions its edgewise compressive strength was 6000 psi. Silicone with an asbetsos core had a shear strength of 57 psi after a half hour at 800 F. Shear strength of the phenyl-silicone panel with an asbestos core was 393 psi after a half hour at 600 F. At the same temperature and time, its edgewise compressive strength was 22,000 psi.

Consider the temperatures encountered in high-speed flight of missiles and space vehicles, it is apparent that these and other plastics have possibilities. At Mach 4, for example, temperatures range between 550 and 1000 F, depending on altitude. At Mach 6 and an altitude of 50,000 ft, skin temperatures will run around 1500 F —cherry red!



MATERIAL	DENSITY (lbs./ft.³)	THICKNESS REQ'D. (in.)	WEIGHT REQ'D. (PSF)	EQUIVALENT WEIGHT (lbs.)
STEEL	489	1.15	47	15
FIBER GLASS PHENOLIC	108	0.83	5.67	1.75
ASBESTOS-PHENOLIC	105	0.47	4.12	1.25
"ASTROLITE" 1201	102	0.39	3.34	1.00

Plastics burn through slower . . .
according to this chart of erosion rates for plastics reinforced with Refrasil. Astrolite is a laminate of Refrasil silica fabric bonded with phenolic resin. This plastic is equivalent to 15 times its weight in steel in resisting burnthrough in 100 seconds



Plastics conduct heat slower . . .
according to chart of three honeycomb sandwich materials. Values are far below those for steel

For want of a nail a WAR could be lost . . .

Are we failing to "measure up" to the Space Age?

Are missile millions wasted by impoverished measurement research and practice? A recently completed Industry Calibration Survey by the Quality Control Committee of the Aerospace (formerly Aircraft) Industries Association leaves little doubt that the "measurement pinch" is critical. Not only are errors of a few millionths of an inch or a few pounds of thrust or minute fractions of a wavelength causing the loss of multi-million dollar space vehicles but, in the light of Russian advances. they may also cost us the missile race and our ultimate security.

Early warnings of the threat recognized by leading producers of space vehicles prompted this thorough survey, which was conducted by Sperry Gyroscope Co for the AIA in cooperation with the U S Air Force and the National Bureau of Standards. The survey, which in the long run affects all of industry, shows that accuracy requirements of advanced space projects are seriously out-distancing U. S. measurement capabilities.

Answers to the survey came from 77 of the nation's leading industrial firms, both large and small, representing manufacturers of missiles, airframes, electronic components, navigation systems, radar, computers and other specialized fields. More than half of these replies are from companies employing more than 5000 people.

The report points out possible trouble areas of calibration by covering the "vital ten" categories of measurement. These are dimensional; optical; temperature and humidity; shock, vibration and force; microwave; radio frequency; electrical; pressure, vacuum and flow; infrared; and radiological. Where the majority of precision measurements ten years ago concerned only the dimensions of objects, today 85% of precision measurements involve electronic or electrical quantities. Many of the newer quantities still lack adequate national standards.

Major parameters, in the survey, are subdivided into specific categories of measurement and, for each element, the best routine accuracy of the National Bureau of Standards is compared with any problem accuracies uncovered. Problem accuracies were determined from a comparison of a company's measurement requirements with its measurement capabilities.

Problem to keep ahead

Normally, the National Bureau of Standards likes to keep ahead of industry requirements by a factor of ten. However, in recent years measurements have become increasingly exacting, and new standards have been required, at such an accelerated pace that the Bureau has a problem even keeping up. In many instances the survey report shows NBS accuracies equal to or better than the problem accuracies stated. Rather than writing this subcategory off as satisfactory, it must be remembered that NBS accuracies *should be* a substantial factor better than those required by industry. Deterioration during transfer stages, from masters to working standards and in transit, make this ratio imperative.

For dimensional standards, 37 out of 63 companies reporting said they recalibrate their standards every 6 to 12 months, while 10 companies recalibrate every 3 to 6 months. Of the 63 companies, 22 consider the National Bureau of Standards the highest source of calibration authority but 30 companies use commercial laboratories for recalibration. Most of the commercial laboratories report that they get their standards from NBS. Traceability to other sources was extremely vague to the survey team.

In view of the importance of calibration of standards, the number of replies showing no outside source seems high. This figure is somewhat tempered by divisional answering units which show calibration at the corporate level, where standards are traceable to NBS. **Extremely significant in the survey replies was that many manufacturers are claiming accuracies that they are not actually achieving. Frequently, accuracy is confused with precision.**

Difficulties in calibration services were claimed by 49 out of 67 companies. Elapsed time is reported as being the single most damaging factor in calibration services. Of the questionnaires 90% mentioned this problem, primarily with reference to NBS services. Non-availability of standards was the second largest area of difficulty. Where reporting companies used commercial calibration services, some reported doubt as to stabilization time, accuracy, or NBS approval.

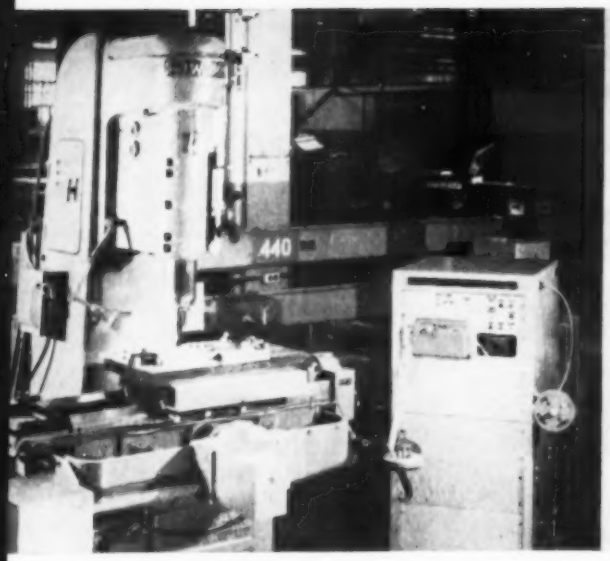
Concern over small ID

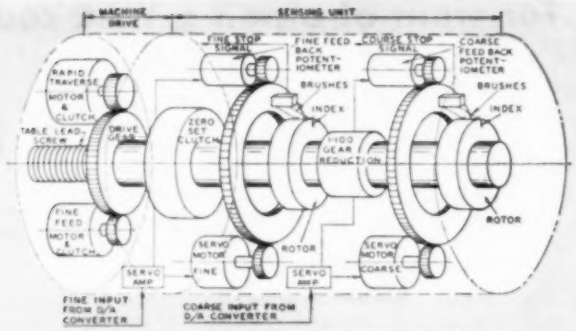
In summarizing the dimensional section, the report on the survey shows that the "length category" is not a problem area. Most companies have accuracies as fine as or finer than those required. **Internal diameters below 0.250 in. provide the area of greatest concern, with internal diameters above 0.250 in. the area of next greatest concern.** It was evident that those companies which did not consider these areas to be problems, claiming accuracies much finer than NBS can attain, are in for a surprise if they actually need the accuracies reported. It is probable that they will be forced to reevaluate their procedures.

Of almost equal concern as internal diameters is the field of external measurements on master disks, plugs and product parts. Companies doing close machining are faced with required accuracies beyond the capabilities of current instruments and procedures. A standard procedure of measurement would help enormously to provide some relief in this field.

Among the actions prompted by the survey are steps to:

- Adopt nationally uniform methods and procedures for transfer of calibrations from primary standards to working standards used by military and industry operations.
- Expand calibration services of NBS to make essential measurement accuracies more readily available.
- Program better education, training, and communications in the field of measurements and standards to insure against future deficiencies.





TELE-PROBOMAT SENSING UNIT SCHEMATIC

For linear or rotary motions . . .
the Warner & Swasey Tele-Probomat is used, here, with a Kearney & Trecker precision boring machine. Control, operating from one-inch eight-channel paper tape, includes a tape reader, control console and two Auto-Set sensing units. Coupled directly to the table leadscrews, the Auto-Set units provide only a pure measurement function. Longitudinal and traverse table motion drives are independent of the measurement function and are conventional rapid traverse and fine-feed AC motors and clutches

Tape suits simple shapes too!

Manufacturing experience with its own products, Tele-Probomat and Pilot-Probomat, is showing Warner & Swasey the many values offered by numerical control—especially for machining small quantities of simple parts. In one instance, numerically controlled inspection is performed on the same machine used to produce the part being inspected

By Peter Rusnov
The Warner & Swasey Company, Cleveland, Ohio

Numerical position control in our shop is in its infancy, but certain trends are clear and the effect of numerical control on our manufacturing can be assessed and predicted.

Numerical control is the precursor of an era in manufacturing in which communication will be addressed directly to a machine rather than to a person who in turn directs that machine. As highly skilled manufacturing pre-planners, by taping manufacturing plans thought out in advance, guide machines, more emphasis will have to be given to organization and training for better pre-planning.

Because more "intelligence will be added to the machine, more information must be fed back to the planner as more and better measurements. Wider use of numerically controlled inspection equipment will enable the pre-planner to receive first-hand data on tool, part, and machine behavior; thus will give him the experience to modify future plans accordingly.

Numerical control will reduce the many judgment and interpretation decisions which must now be made by the workman and inspector, by providing a tape in which many of these factors have already been considered and resolved.

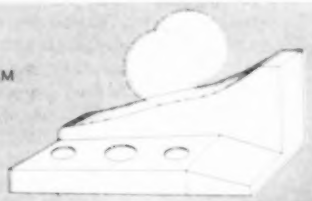
Apart from the usual benefits of higher machine productivity, improved product quality and shorter lead time, numerical control will give industry a degree of flexibility as yet undreamed of. With the production knowledge stored in the tape, rapid change-overs from product to product can be made, parts can be made in several areas or plants without duplicate special tooling, areas of business hitherto unprofitable can be sought out. Valuable space can be saved by scrapping jigs and fixtures for obsolete repair parts and creating tapes which contain all the production know-how of the tools, simply filed until needed to fulfill an order.

We first applied numerical position control in our

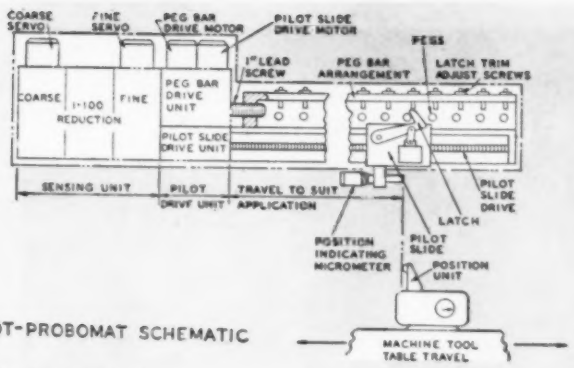
SPECIAL SPACER PLATE

METHOD I		METHOD II		METHOD III	
ALTER PRESENT DRILL JIG. DRILL 25 PCS. IN DRILLING DEPT.		JIG BORE HOLES MARKED X IN TOOL ROOM USE PRESENT DRILL JIG FOR OTHER HOLES		BORE ALL HOLES ON NUMERICALLY CONTROLLED PRECISION BORING MACHINE	
JIG ALTERATION	$175.00	JIG BORING		TAPE PREPARATION	
DRILLING		SET UP - 7 HR.	$ 4.55	3.5 HRS.	$ 16.10
SET UP - 3 HRS	2.40	BORING - 15.0 HRS.	97.50	PRECISION BORING	
DRILLING - 1.5 HRS.	12.00	DRILLING		SET UP 1.5 HRS.	12.00
TOTAL COST 25 PIECES	$ 189.40	SET UP - 3 HRS.	2.40	BORING 7.5 HRS.	60.00
		DRILLING - 1.12 HRS.	9.04	TOTAL COST 25 PIECES	$ 88.10
		TOTAL COST 25 PIECES	$ 113.49		

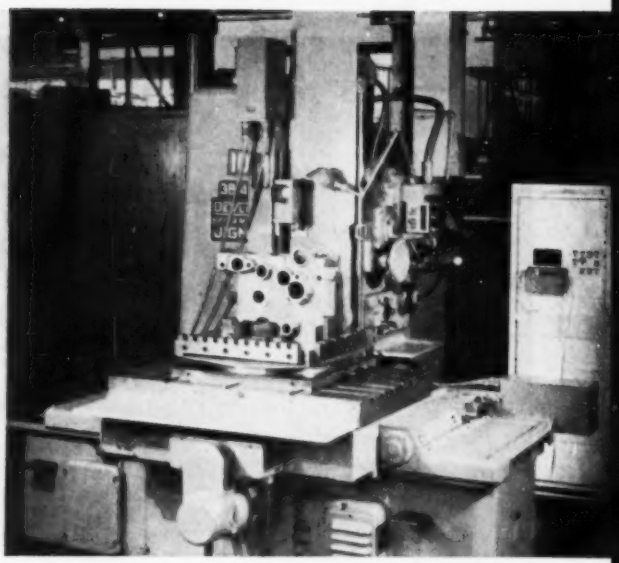
OPENING CAM



METHOD I		METHOD II		METHOD III	
MILL CONTOUR ON TRACER CONTROL CAM MILLER		JIG BORE CONTOUR IN TOOL ROOM		MACHINE CONTOUR ON NUMERICALLY CONTROLLED PRECISION BORING MACHINE	
HOLDING FIXTURE	$ 250.00	JIG BORING		TAPE PREPARATION	
PURCHASED MASTER CAM	150.00	SET UP 1.0 HR.	$ 6.50	2.0 HRS.	$ 9.20
MACHINING		BORING 125.0 HRS.	812.50	MACHINING	
SET UP 1.5 HRS.	12.00	TOTAL COST 25 PIECES	$ 819.00	SET UP 1.0 HR.	8.00
MACHINING 12.5 HRS.	100.00			MACHINING 43.25 HRS.	346.00
TOTAL COST 25 PIECES	$ 512.00			TOTAL COST 25 PIECES	$ 363.20



PILOT-PROBOMAT SCHEMATIC



Positioning control . . . mechanically independent of the machine drive is provided by the Pilot-Probomat. To control linear movement, two units are attached to the DeVlieg Jig Mill, one each to the base and column. These units control the machine by actuating a pilot slide carriage along the axis of motion to the programmed position. Peg-and-pawl mechanism, with pegs spaced exactly one inch apart, controls movement of pilot slide carriage to nearest inch. Decimal setting between inches is by a one-inch-long precision leadscrew

shop to a precision borer and a precision boring and milling machine. A Warner & Swasey Control Division Tele-Probomat system was fitted to the Kearney & Trecker precision boring machine and the Pilot-Probomat system to the DeVlieg Jig Mill.

In the Tele-Probomat system both command and numerical information appear on the tape. The command information selects the axis and direction of movement and the numerical information represents the programmed dimensions. The tape reader scans one line at a time and stores the information in a bank of stepping switches.

At the start of the positioning cycle the rapid traverse motor for a given axis is energized and continues its operation until one of two Auto-Set units indicates correspondence to the input signal. The Auto-Set unit employs a coarse and fine range so that actually two correspondence signals are generated. The first signal de-energizes the rapid traverse drive and starts the fine feed and the second signal de-energizes the fine feed and applies the brake.

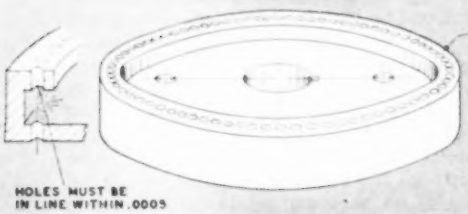
The Auto-Set units attached directly to each leadscrew have an accuracy potential of 0.0002 in. However, as in most applications of numerical control, the machine itself is the important factor in determining the actual total working accuracy of the system. A zero-set clutch is used between the Auto-Set unit and the leadscrew to enable the control to be uncoupled from the leadscrew. Thus the machine table or part can be set to a zero reference in coincidence with the zero reference in the control unit for faster setups. Two Pilot-Probomat units are attached to the DeVlieg Jig Mill, one each to the base and column. They control the machine by actuating a pilot slide carriage along the axis of motion to the programmed position. The table or spindle head is driven until the DeVlieg sensitive limit-switch position indicator contacts the pilot-slide carriage to stop and position the machine table and spindle. A peg-and-pawl mechanism, with pegs spaced one inch apart, controls the movement of the pilot-slide carriage to the nearest inch. Decimal setting between inches is accomplished by a one-inch-long precision leadscrew actuated by the control system. A tape controls the slide carriage position and other auxiliary functions of one, two, or more axes of the machine tool. The peg-and-pawl system can be calibrated and adjusted on the machine.

Before final testing of the Tele-Probomat control on the precision borer had been completed, Production Engineering asked whether we could make master and prototype cams at less cost than conventionally. The most difficult cams we produce are the high-accuracy master cams for production and inspection.

A tape was punched to locate 720 points at ½ degree intervals on the cam and we built a single fixture.

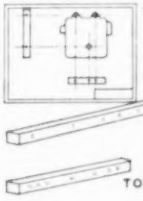
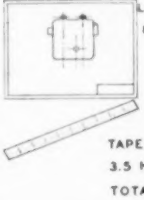
Spindle movement of the precision borer was auto-

MEMORY WHEEL

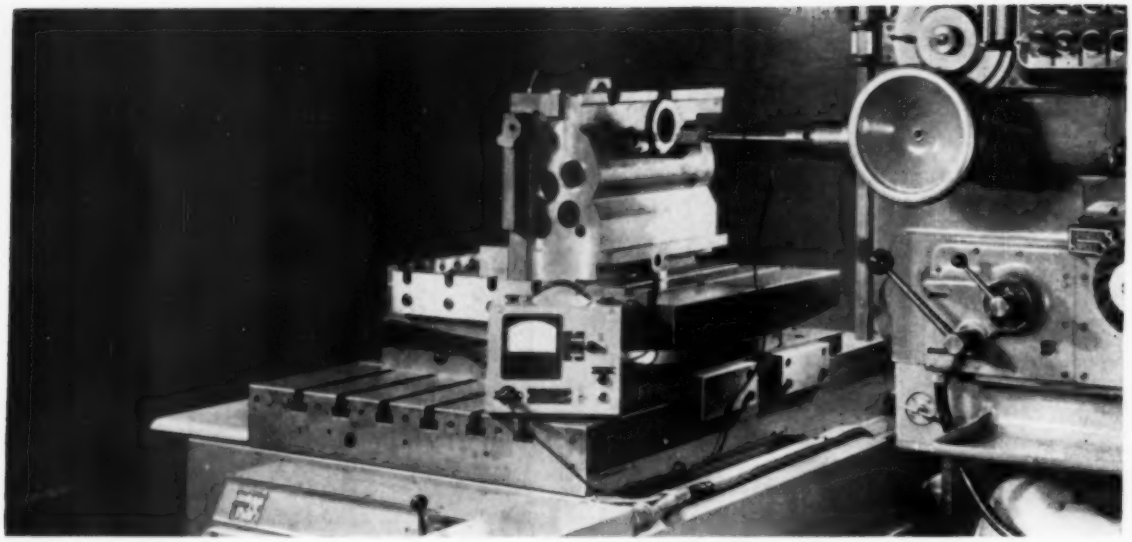


METHOD I		METHOD II	
JIG BORE 120 HOLES IN TOOL ROOM		BORE 120 HOLES ON NUMERICALLY CONTROLLED PRECISION BORING MACHINE	
JIG BORING - SET UP AND BORING 20 HOURS	$130.00	TAPE PREPARATION 6 HOURS	$27.60
		PRECISION BORING 8 HOURS	64.00
TOTAL	$130.00	TOTAL	$91.60

GEAR BOX TOOLING COST COMPARISON

METHOD I	METHOD II
DESIGN & BUILD HORIZONTAL AND VERTICAL MEASURING BARS FOR PRECISION BORING AND MILLING MACHINE	PROGRAM AND PREPARE TAPE FOR NUMERICALLY CONTROLLED PRECISION BORING AND MILLING MACHINE
 TOOL DESIGN 16 HOURS $73.60	 LAYOUT & PROGRAM 8 HOURS $36.80
VERTICAL BAR TOOL MAKING 10 HOURS $65.00	
HORIZONTAL BAR TOOL MAKING 11 HOURS $71.50	TAPE PREPARATION 3.5 HOURS $16.10
TOTAL COST $210.10	TOTAL COST $52.90

Tape suits simple shapes tool . . .



Electronic indicator . . .
checks size and location of holes, guided by an inspection tape prepared by Quality Control. Used in conjunction with the accurate DeVlieg Jig Mill for positioning, the tape-plus-indicator combination offers multiple manufacturing advantages

mated and controlled as an auxiliary function by the control console as all 720 points could be programmed without a stop for cutter change.

Because the accuracy of the conjugate-cam system depends upon the accuracy of the master and counter cam profiles relative to each other, boring the center and locating the dowel hole had to be programmed into the tape along with the contour. Master cam profiles thus produced by using a position-to-position system for contouring were well within 0.001 in. of the true position or profile. Generally, these cams cost 35% less than cams made by previous methods.

One cam made in lots of 25 on the numerically controlled precision borer cost less than the tooling for contour-control cam miller. Special separator plates with non-standard hole spacing were bored within ±0.0004 in. without tooling on the numerically controlled precision borer. Previously standard holes were machined using standard tooling and special holes were jig bored in the toolroom. This division of responsibility led to errors. The tape controlled precision borer reduced rejects, eliminated human error and decreased the cost 22%.

The precision borer, even though it is position-to-position control, because of its fast cycle and auxiliary spindle control, has had its greatest work load in the area of contouring cams. Our design engineers prize this machine for quickly producing special cams and parts needed for testing the practicability of new designs. Our manufacturing group sees it as a device to process rush design changes.

The Pilot-Probomat on the DeVlieg Jig Mill controls only the longitudinal saddle movement and the vertical-spindle head travel. It is not tied electrically to the DeVlieg automatic positioning function but operates in conjunction with it and takes the place of the horizontal and vertical end measures, blocks, or bars. A machine-tool gear box was bored to an accuracy of ±0.001 in. using the Pilot-Probomat numerical position control in place of the standard fixed horizontal and vertical bars. The cost of tape preparation was considerably less than the cost of designing and building vertical and horizontal jig bars.

One of the most promising potential uses of this machine is seen in its ability to quickly and accurately inspect its own work by numerical control. Whether the inspector brings his tape to the machine to inspect the part or whether the pre-planner chooses to make the inspection function a part of the machining operation is immaterial, the advantages are the same.

Although numerical control was conceived to machine complex shapes, its great future is likely not to be as much in the manufacture of complex parts as in the production of relatively simple parts. Some thought should be given to the design of parts now on drafting boards for processing on numerical-control equipment.

Guide to success

A few general design principles, based on our experience thus far, are:

1. Simplicity must be the by-word from the earliest conception of a design. A simple configuration can only reflect in fewer operations, fewer cutting tool changes, optimum feed rates and simpler holding devices. The simple shape can be easily cast, clamped, located, made, inspected, handled and stocked.

2. The inherent rigidity of the simple part allows full power of the tool to be transmitted to the cut and simplifies programming by eliminating choice of and need for rough and semi-finishing and stress-relieving operations. The simple shape allows drilling and boring with short drills, bars, and cutters with minimum extension of spindle or quill to utilize full power and accuracy of the machine tool. The box or square prism shape lends itself to milling, drilling and precision boring operation in one setting, or chucking on an index table to insure accurate relationship between holes and surfaces.

3. Irregular shapes with non-uniform and abrupt changes in section lead to unpredictable part response as internal stresses are relieved. Deflection of the part by the cutter forces should be avoided.

Die blocks are contoured . . . Converted router produces better dies at lower cost to meet increased demand for hot-forming tools

Rebuilt router contours hot-forming dies

Steel and cast-iron dies for hot-forming jobs are now being fabricated at Ryan Aeronautical Co, San Diego, by a rebuilt Orton variable-tilt shaper. The machine has been converted — with 32 separate improvements — to operate 24 to 50 times faster than previously. It outperforms conventional sawing and filing, and replaces operations at a Keller or 3-D Hydrotel.

These changes were made in the basic machine:

- Replace all studs and nuts with hardened parts
- Tighten ways and add wipers
- Replace old motor with a totally enclosed, statically and dynamically balanced motor of higher power
- Add oil-mist lubrication
- Install heavy-duty spindle
- Develop special winch to pull work through the machine
- Add brazed carbide-tipped cutters

The new cutters can machine 40 ft of steel without resharpening. They work with special chucks developed to take the higher loads.

Die cutting is started by bolting a templet to the top of the block and placing the assembly on the router table with the templet in contact with a stationary guide. The block is pulled past the cutter by one operator, who uses the winch. A second man operates a handwheel to tilt the spindle assembly. This tilting produces a swarth — or changing-angle—cut along the top of the die block. The carbide cutter rotates at 10,000 rpm, cuts 0.02 in. deep, and feeds at 5 ipm on cold-rolled steel or high-temperature Meehanite cast iron.

Too many welding codes?

A single welding code made up of subsections, each dealing with a specific application or industry, has been recommended by Howard Cary, director, Hobart Brothers Technical School, Troy, Ohio.

Trouble today, according to Mr Cary, is that there are just too many conflicting welding codes around — American Welding Society has one, American Society of Mechanical Engineers another, Canadian Standards Association still another, and so on.

"Codes are not written to hamper the use of a particular manufacturing process, but to protect the life and property of the public," he said, adding that when a number of codes are considered they become confusing.

Recommended by Mr. Cary is a consolidation of existing codes along totally new lines. For instance, a single welding code could be made up of sections applicable to (1) various operations, (2) various industries, and/or (3) providing for varying levels of quality.

Along with this code would go establishment of accepted practices in radiography inspection, magnetic particle inspection and the like. Purchaser and supplier could then reach an agreement within this framework.

Also in conjunction with the single code would be a breakdown of operator qualifications at various levels of proficiency—a pattern resembling that employed in licensing airplane pilots. Thus, according to Mr Cary, operator qualifications could allow for hiring of an operator without requiring him to re-qualify, but adequate records would be needed, and safeguards required.

Adoption of a single code with multiple provision would, in Mr Cary's opinion, eliminate countless duplications of tests to qualify processes, joint designs and procedures. And it would avoid duplication of tests to qualify an operator each time he is hired by a new employer.

Savings to fabricators would be "enormous," Mr Cary thinks, "and the final result would be lower cost welding. . . . Only by means of minimum standards can we maintain an orderly arrangement between buyer and seller that will protect the life and property of the public and retain confidence in welding."

1 . . . Controlled atmosphere grinding area

2 . . . Precision lapping

Precision calls the turn on

Putting ultra-precision into an already precise product is the aim of Norma-Hoffman Bearings Corp's new "add-on plant" at Stamford, Conn. Designed and built by Norma-Hoffman engineers, the new facility can turn out $1 million worth of ultra-precision angular contact bearings a year to meet fast-increasing demand by the aircraft and missile industries, by makers of precision machine tools, electronic brains and many other space age products.

To do the job, Norma-Hoffman has created unique techniques and machines, housing its operations in a controlled environment.

The grinding area, for instance, (Fig. 1) is fully air conditioned, with temperature held within ±1° of 70 F, and relative humidity between 45 and 50%. Coolant and power lines are under the floor. Material comes into the area in lots of 3000 pieces. Rings then move to the face grinder, to the lapping machine and centerless OD grinder (foreground, Fig. 1).

End faces of inner and outer rings, which have already been ground, are precision lapped simultaneously (Fig. 2) to insure such accuracy that the faces can later become locating surfaces for subsequent grinding.

Pieces are inspected after each operation (Fig. 3), with the operator himself doing the inspecting. Output of centerless OD grinders, for instance, is checked with air gages, is also hand gaged before the next operation.

ID of inner and outer races is ground on a shoe-type centerless grinder (Fig. 4), which incorporates a fluid-pressure clamping device to hold large work against the rotating backing plate without distorting the race. Grinders load and unload automatically.

In-process inspection

Throughout the operation, a constant check is kept on dimensional accuracy. For instance, output of the ball track grinder is checked by special gages that feed an electronic amplifier which reads in steps of 0.0000025 in. An extra-fine surface finish (cuts bearing noise level, insures lower starting and running torque) is honed on the ball track by N-H-designed machines.

Next, the finished races are washed and rinsed, and rust inhibitor is applied before they move into assembly areas.

Assembly area (Fig. 5) is air-conditioned, kept free of dust by an automatic filter on the outside air intake.

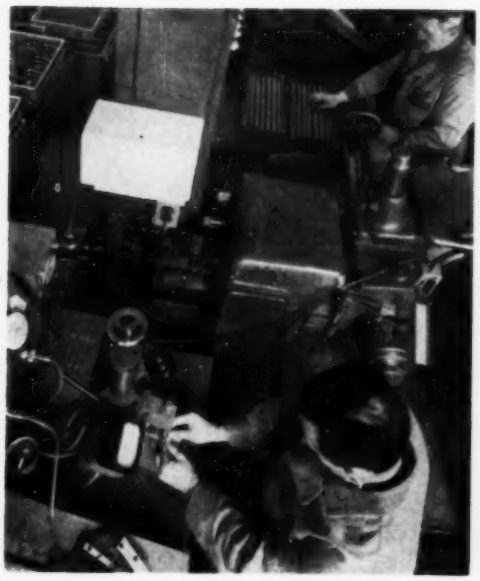
Final preload grinding (Fig. 6) is done on rotary surface grinders equipped with automatic in-cycle, air-gaging which measures the height of the ground face above the chuck with each stroke of the table. Gage is interlocked with feed mechanism to prevent over-grinding.

In detail, Norma-Hoffman's new technique for preload grinding (patent pending) works this way: End faces of matched pairs of inner and outer races are face ground to such accuracy that when the assembled bearing is compressed into its normal mounting position, the balls will be subject to the desired preload pressure as the end faces of both races draw up exactly flush.

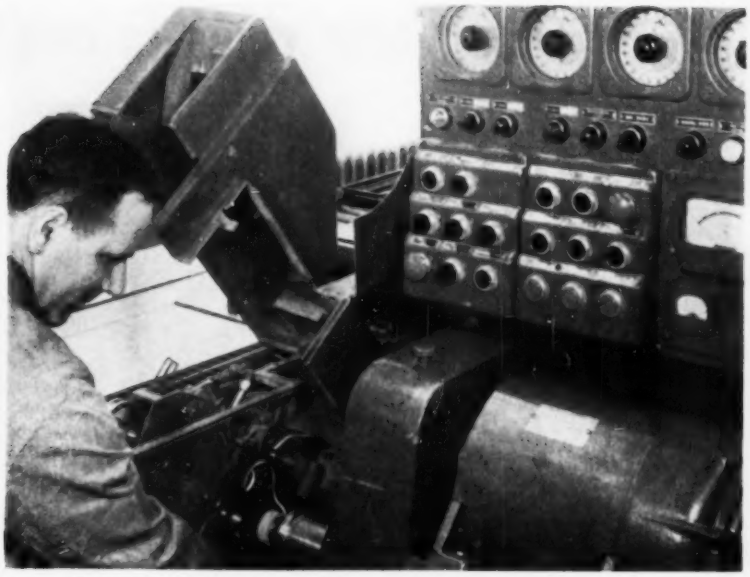
As inner and outer rings are assembled with the balls and retainer, ring faces are not aligned—the face of either the inner or outer ring sticks out beyond the face of the other because of a slight variance in race-to-faceway diameter. Normally, bearing makers grind as close as possible to finish size, gage the parts, and regrind until the right finish size is obtained.

Controlled accuracy

Norma-Hoffman now controls race-to-face dimensions to such accuracy that only one variable is present when the matched rings are ready for preload grinding, and automatic



3... Constant inspection



4... Grinding ID of inner and outer races

bearings

in-cycle air gaging measures stick-out during grinding.

A pair of races is selectively assembled with a set of matched balls, then assembly is preloaded to specified pressure and gaged to determine the amount of stock to be taken off the faces. After disassembly, the races are finish face-ground on Heald 161 rotary surface grinders.

These rotaries are equipped with automatic in-cycle air gaging that measures the height of the ground face above the chuck at each stroke of the table. Measurement registers on a large dial indicator on the control panel. Gage is interlocked with the feed mechanism to prevent accidental over-grinding. By this method, Norma-Hoffman can produce bearings that can be mounted universally in any duplex arrangement.

Norma-Hoffman claims that it not only has "the most modern machinery, methods and instruments available to the bearings industry" in its new facility, but that many of its techniques and operations are unique: deep-freezing of stock after heat treatment to control dimensional stability and hardness; precise in-process inspection at each machine to measure work to 0.0000025 in.; achievement of lower microinch finish than ever before with special honing equipment.

5... Dust-free, air-conditioned assembly area

6... Final preload grinding

Mash welder joins rings in one operation

By Bruce R Bagley,
vice president,
Yale Stamping Co,
Detroit, Mich

Better welding cuts the cost of rings for V-belt sheaves 10-15% at a production rate of 400/hr. This improvement is based mainly on welding the rings complete in one operation instead of two. Older methods required flash butt welding, which left considerable flash for cleanup. Now mash welding leaves only a slight expulsion at the lap—and this can easily be trimmed.

Production is at a Sciaky EP-2 200-kva projection welder equipped with special long electrodes and a pneumatic fixture that locates and clamps the preformed steel strips automatically. The fixture has a Z-shaped opening into which the two ends of the strip are inserted so they will overlap. The operator trips a pedal switch when the strip is in position, and two pneumatic side clamps grip the band between upper and lower electrodes. When these clamps have closed, the Z-bar automatically retracts, bringing the lower electrode into welding position against the work.

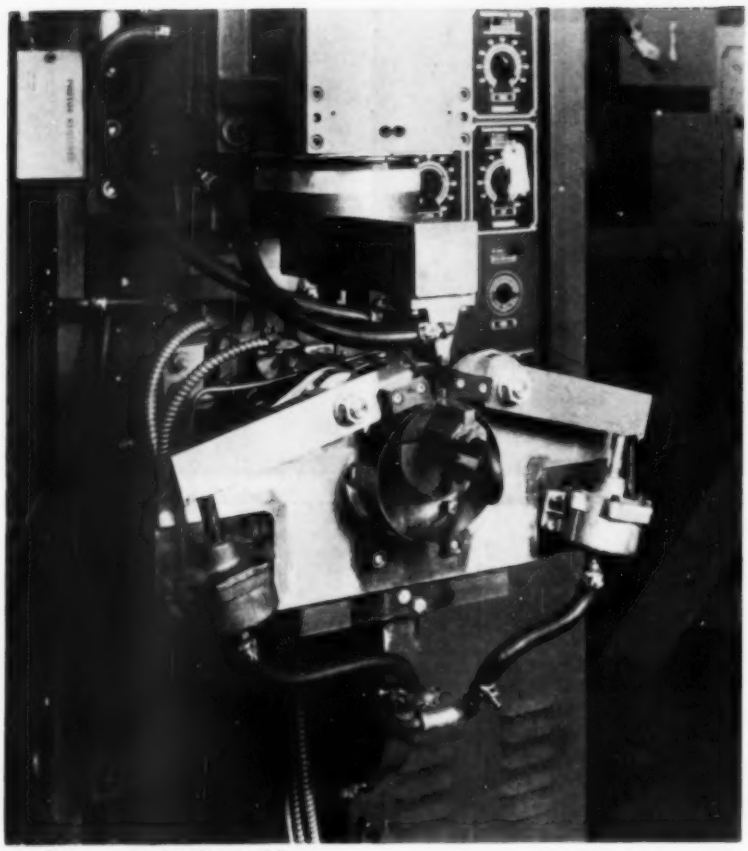
Achieves 3000-lb electrode force

Maximum electrode force is 3000 lb, developed from shop-line pressure of 80 psi. Maximum secondary welding current is 69,000 amps. For most rings the electrode force is only held to 1800 lb, and the squeeze, weld, hold, and off timers are set to the minimum required for a clean, sound weld. Timers for heating and cooling are set to suit the width of the rings being processed—from 1 5/16 to 1⅞ in. Stock is 0.05 in. thick, and rings are formed to diameters from 5 to 8 in.

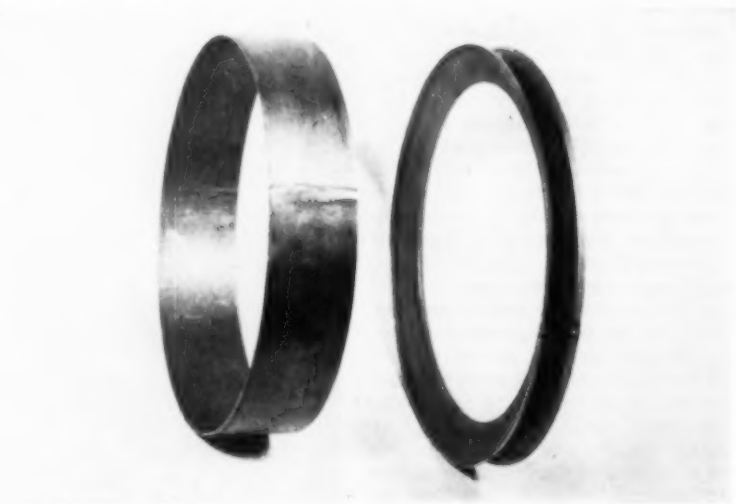
Controlling ring accuracy

Because of the method of locating the rings in the welder, the ring diameters are controlled by the accuracy to which the strips are sheared to length—which results in accuracy to ±1/64 in.

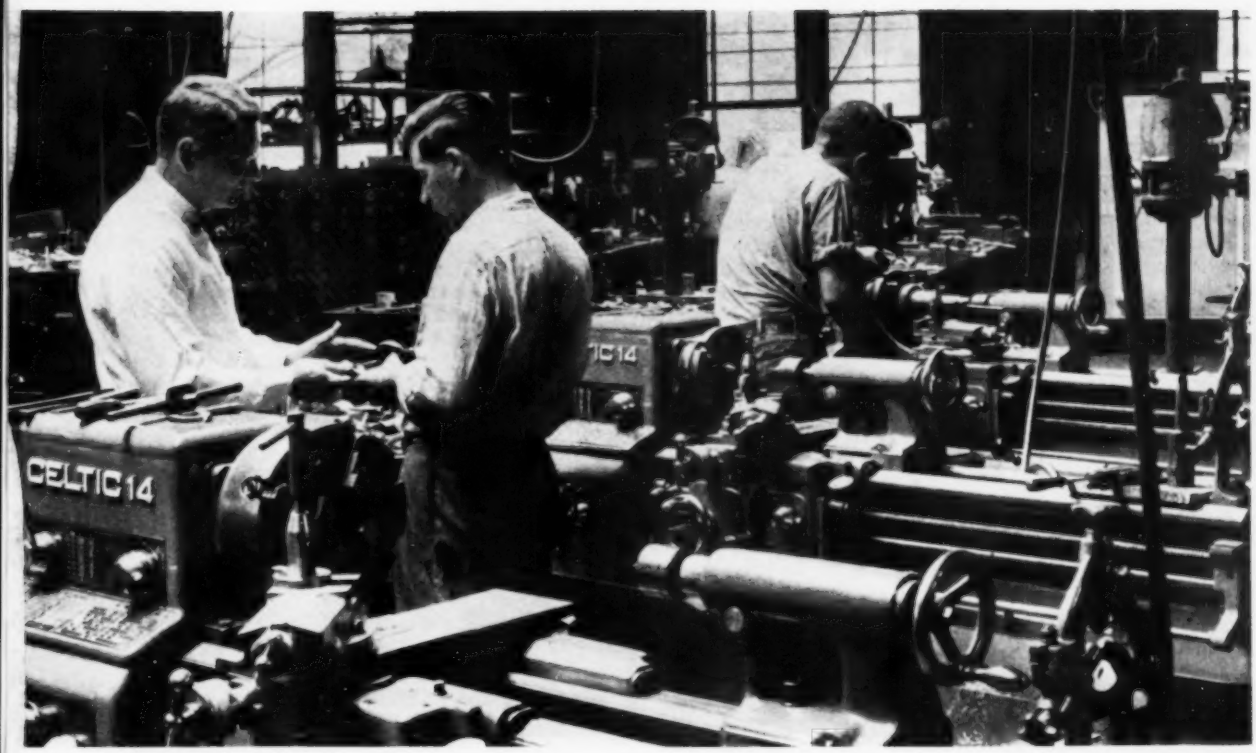
The rings are formed into belt sheaves for fan drives, generators, air pumps, and guide pulleys. Rollers form the V shape, then a special press die expands them to final size. Sheave OD's are held to within 0.005 in. of required dimension, and ID's are held within 0.003 in.



Air fixture on Sciaky welder . . .
locates and holds strip steel for seam weld. After stock is located, lower positioner withdraws to admit lower electrode



Welded, trimmed ring . . .
is roller-formed and sized in a press die to form a V-belt sheave for automobile applications. Diameter of ring is held within 0.01 in.



Faster jobbing . . .
Stanley Errington and his lathe operators find that modern machines cut down time on regular and contract work. They like features such as bed inserts that can be removed to provide a gap for large workpieces. Lathes are placed at an angle to the aisle, as is common with screw machines, in order to gain extra space for benches and work in process

Mortgage money may give you a new start

By Rupert Le Grand,
senior associate editor

It's fine if you can pay cash on the barrel head when buying new equipment. But if you lack reserves for a good modernization job, take a look at why one small shop mortgaged its plant to build a brighter future

If you are ultra-conservative, you will say that it is unsound to buy equipment on time.

So you go along year after year, hoping for a break. Maybe a war helps out. A few good years may put something extra in the till and you get a few new machines. But costs keep going up, your shop gets more obsolete all the time. How long can you last?

This question baffled Stanley Errington, 3rd-generation president of the Errington Mechanical Laboratory, Inc., Staten Island, N. Y. The family firm was started in 1891 by Franklin Errington, inventor of the automatic tapping chuck. In succeeding years, drillheads and automatic screwdrivers were added to the line. Basically all of the firm's products stem from the grandfather's patents.

Although the grandson had good products, his shop was filled with antiquated equipment. *The shop was still belt driven in 1958.* Some modern pieces of equipment had been installed since 1940, but on the whole the shop was no place that Stanley Errington wanted to show to customers . . . particularly those who would give him profitable jobbing and fixture contracts, based on the firm's reputation for good work.

Mr. Errington planned to modernize in two directions: (1) the shop, and (2) management and distribution practices. Moneywise, the first was the more serious problem.

A good deal of the work on the company's product lines involves turning on engine lathes. The 40-to-50-yr-old lathes obviously could not use carbide tooling. Operators had to take four to five cuts on a piece, when one or two should suffice. Because of belt drives, etc, the shop was cluttered, space was at a premium. Working conditions encouraged sloppy housekeeping.

To get into jobbing and fixture work, Errington needed jig boring and grinding capacity greater than that provided by a Moore jig borer and a No. 1 Brown & Sharpe surface grinder bought in the Forties. Eventually it is hoped to have 50% of the shop's output in terms of standard products and 50% on contract work, with both sides of the business acting to strengthen the other in respect to shop facilities, engi-

Errington's Experience With Modernization

- • • Only 1½ days' production was lost in affected departments when new equipment was installed.
- • • More space is available in the shop.
- • • The clean-up program got rid of 7 tons of junk.
- • • The men like the improved appearance of the shop and take more interest in their work and the company.

neering talent and in management.

Phase 1 of Errington's modernization and expansion program thus consisted of buying the essentials and adding some inspection equipment as warranted. Eight belt-driven lathes were sold (they wound up in Mexico). Replacements are:

Six lathes—one with 17-in. swing and up to 25-in. gap, and five 14½-in. lathes with gaps to 21¼ in.

One ram-type vertical miller with 36-in. table.

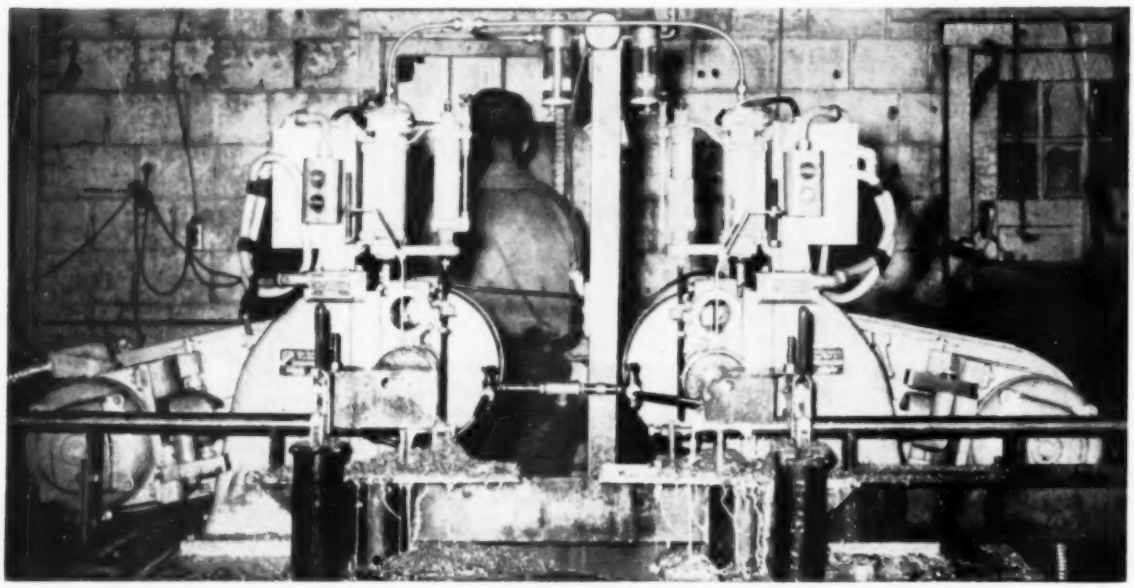
One No. 5 Brown & Sharpe surface grinder.

Total cost—$36,000. It is expected that these machines will pay for themselves in three years on the anticipated volume. They will be depreciated over a five-year period.

As a long-established business, Errington could have financed the machine purchases or obtained a line of credit from its banks. It was decided that a 10-yr mortgage on the plant was a better solution. The reasons are: first, amortization and interest payments are relatively low, and can be handled on less than a normal volume of business. Second, the interest on the mortgage will be offset in good measure by the depreciation allowable on equipment.

No further large purchases of equipment will be made for at least two years. Development and strengthening of product lines, improvement of distribution, and growth in the contract field will absorb the firm's energies.

From the order books and active prospects, it looks as though Mr. Errington has set his house in order just in time to profit from the expected upsurge in business. At least, as the company approaches three score and ten, its 3rd-generation president has thrown ultra-conservatism out of the window in favor of a dynamic, yet practical, approach toward forging ahead in business instead of slipping behind. His way to do it: Use other people's money through the medium of a long-term mortgage that can easily be handled, and work off the mortgage before you buy more equipment.



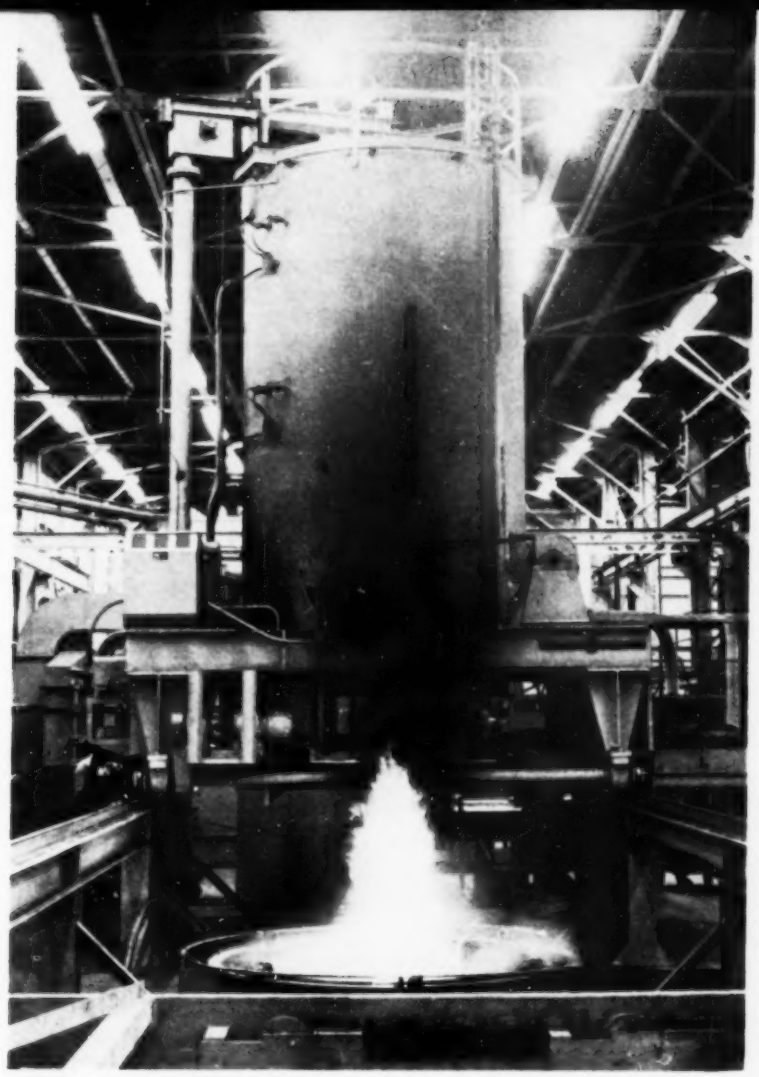
Two U S half-mills . . . cycle together to cut Woodruff keyways in shafts for farm machinery. Operator clamps shafts of any diameter or length in V-block fixtures, then trips switch. Mills come down, feed to depth, then retract

Tandem millers cut keyways faster

Two parts are machined at the same time to increase production efficiency on keyways by 125% at Brady Manufacturing Corp, Des Moines, Iowa. And what little time is required for manual loading and unloading at the keyway millers is borrowed from a screw-machine operator's unproductive minutes; so labor on the keyway job is practically free, compared to older methods.

The keyways are cut in fairly long shafts of mild, cold-rolled, or stress-proof steel which go into farm pulverizers and hay conditioners. Two are loaded at a time into fixtures at opposed millers, one right-hand, one left-hand. Heads and motors of the mills are balanced on a common bearing-supported pivot arm, which provides sensitive vertical feed motion. After the fixtures are loaded, the operator trips a switch. The millers rapid traverse down, feed to depth in the work, rapid traverse up to start position, and shut off. Interlocking limit switches control the 4-in. vertical stroke of the air-hydraulic heads.

Another tandem installation of No. 1 U S half-mills is operated by a lathe man to cut keyways in cylinders turned on the lathe.



Traveling bell furnace . . .
heat treats rocket motor cases. This open-end-down furnace straddles a pit which encloses a loading area, quench tanks, and a pit-type draw furnace. Here, case has just been lowered into oil quench tank

Electric furnaces solve tough heating problems

Many new materials call for heat treating techniques involving higher temperatures, closer temperature control, special atmospheres, or high vacuums. The modern electric furnace can meet these, and many other, heating problems

J E Friess, district industrial heating specialist, General Electric Co, Philadelphia

Why the increasing interest in electric furnaces? The answer lies in the increasing use of new alloys that require higher forming temperatures and closer heat treatment control, and in the demand for higher production. Naturally there are problems, and they affect the furnace builder, the metal producer, and the heat treater. Here are the major problems:

Temperature — Until recently, annealing and sintering temperatures seldom exceeded 2050 F, although temperatures to 3100 F have been attainable in small furnaces. Today, annealing temperatures of 2350 F are desired for many alloy steels, and hot-working temperatures of 2800 F are needed for the rare metals. Temperatures approaching 4000 F will soon be needed. Not only must furnaces meet these requirements, they must also be large enough to meet expanding production requirements.

Atmospheres — Protective atmospheres have been used for years to prevent oxidation of heated metal surfaces, to allow fluxless sintering and brazing, and to maintain or increase carbon content. For such jobs, atmosphere purity can be maintained in furnaces in which the work is exposed to a refractory lining. However, many of the alloys in demand today, most of which have high chromium contents, cannot be exposed to the furnace refractory because of oxidation of the metal surface. Such metals must be processed in sealed boxes or muffles.

The desirable properties of the rare metals are impaired when such metals are heated in the common protective atmospheres. They must be processed and treated under vacuum, often with vacuums in the 1- to 10-micron range (0.001 to 0.010-mm Hg).

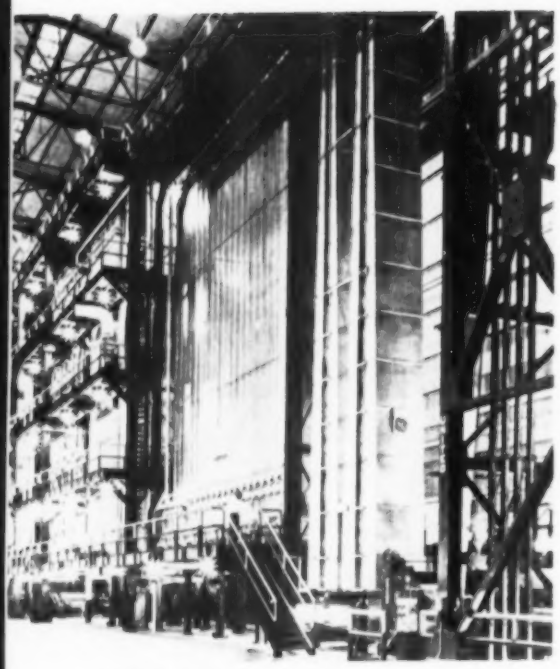
Materials—All the heat-resistant alloys lose strength rapidly at temperatures above 2000 F. This severely limits the temperature attainable in a furnace because many furnace parts—muffles, chains, belts, rollers—are made of metal.

The refractory materials currently used in furnace linings are subject to chemical changes at high temperatures in the presence of hydrogen, the usual reducing component in protective atmospheres. This reaction forms minute quantities of oxygen which then form water vapor, and this moisture causes oxidation of medium- to high-chromium alloys.

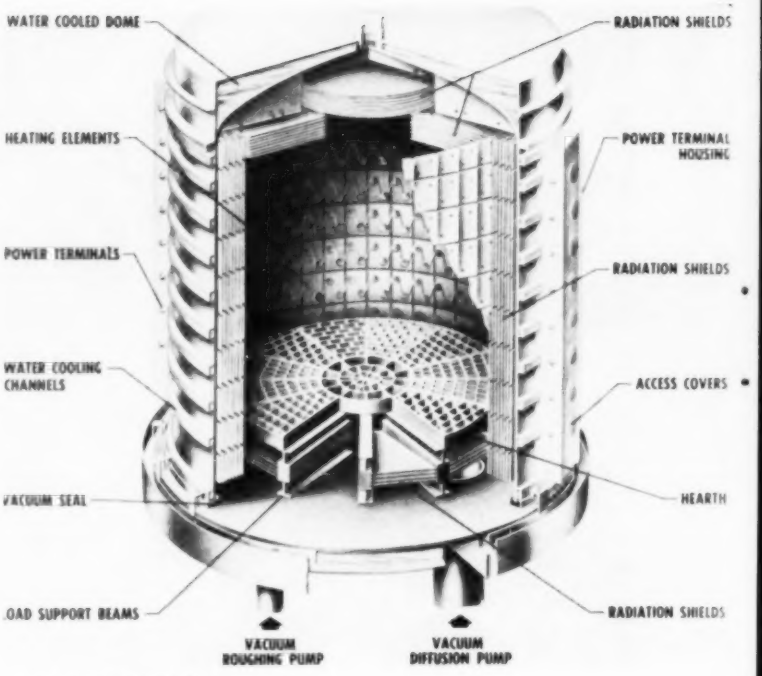
Large lightweight parts—Many aircraft and missile parts are large but, because they are made from sheet-metal, are quite light. Such parts present three problems: (1) If the part must be quenched, temperature loss in going from furnace to quench must be minimized; (2) parts must be supported in furnace; and, (3) distortion must be controlled.

Electric furnaces do the job

Electric furnaces have overcome many of these problems and promise to furnish additional solutions



Tinplate annealing furnace . . .
as tall as a 6-story building, continuously anneals light-gage steel strip under closely controlled temperature and atmosphere conditions. Current strip speed is 1000 fpm, will be doubled in future furnaces



Radiant shield furnace . . .
uses no refractory lining, permits high vacuums and high heating and cooling rates. Heating elements and shields are made from rare metals. If tungsten is used (melting point 6186 F), furnace can operate at 1000 F or higher. Furnace can also be designed as a horizontal unit

for today's and tomorrow's, heat processing problems. Here's how:

- Heating-element materials are now available for temperatures to 4000 F under high-purity atmosphere or vacuum.
- Temperature uniformity can be maintained because electric elements can be mounted so as to cover the furnace walls and provide uniform heat distribution. If necessary they can be concentrated in areas of higher heat loss to provide for the losses and still maintain the required heating rate.
- Electricity is non-contaminating. There are no combustion products to contaminate the atmosphere or vacuum.
- Electricity is more efficient than fuel-firing at higher temperatures and, therefore, is cheaper.
- The life of metallic furnace parts is longer in an electric furnace because there are no "hot spots" as there often are in fuel-fired units. Also, the development of a new "high-purity" refractory is eliminating the need for muffles and retorts in many applications.
- Only a minimum number of openings need be made through an electric furnace wall, and these can be sealed quite easily, making the furnace atmosphere- or vacuum-tight.

History of electric furnace

A short look at the evolution of the electric furnace will show how furnace design has changed to meet current problems.

The original electric furnace was a reinforced sheetmetal box lined with refractory and insulation. It was a box furnace, a bell furnace, or a pit furnace, depending on whether the opening was in the front, the bottom, or the top. As protective atmospheres were developed, the enclosure was made gas-tight.

Increased production then made it desirable to turn out more work per square foot of floor area and per man-hour. This resulted in the continuous furnace. One type was the continuous mesh-belt furnace, in which a water-jacketed cooling section brings work temperature down to a point where the work can re-enter the room air without discoloring. These furnaces have been used largely for annealing and brazing. As a companion furnace for the hardening field, the cast-belt conveyor furnace was developed. Here the belt consists of cast links. The heated work drops from the belt into a quench tank, from which it is removed by the quench tank conveyor.

Both of these belt furnaces are limited in length, and the mesh belt is limited in the concentrated load it can carry. To meet these problems, the pusher furnace and the roller-hearth furnace were devised. The pusher furnace has a pushing mechanism at the charge end that pushes work-loaded trays through the furnace on two rails. Though it can carry heavy loads, this furnace, too, is somewhat limited in length.

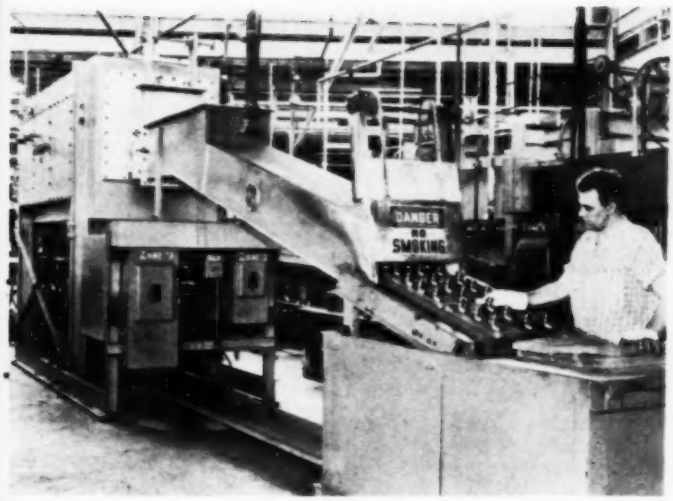
In the roller-hearth furnace, the work is carried on lightweight trays over a series of driven rolls that extend the full length of the furnace. This furnace has no limitation on its length.

Thousands of the furnaces already described are in use today and will be used for many years to come.

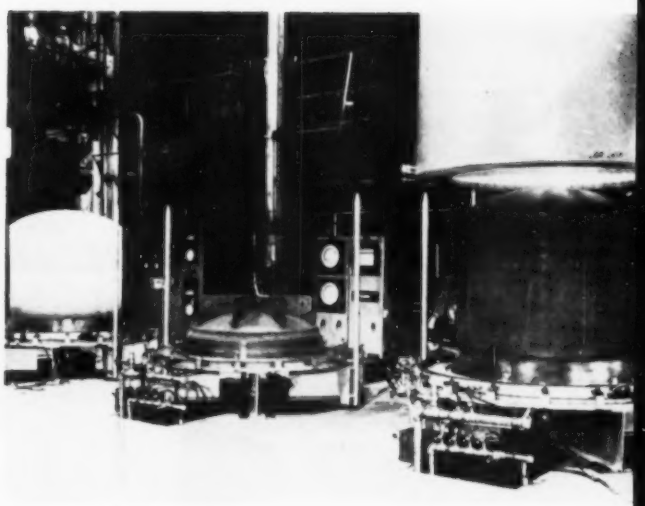
Modern furnaces

The problems outlined in the beginning of this article cannot be met by the older furnaces, what with their limited temperature ranges, limited capacity, and limited versatility. Let's look at the latest developments in electric furnaces.

From the standpoint of size, one of the most spectacular develop-



Hump-type mesh-belt furnace . . .
permits bright annealing, brazing, and heat treating of stainless steel without oxidation or discoloration. Heating and cooling sections are elevated to prevent entrance of air. New "high-purity" brick is not affected by hydrogen atmosphere



Standard bell furnace . . .
bright brazes stainless-steel jet-engine sections under hydrogen or argon atmosphere. Rocket cases can be heated and quenched in such furnaces. Liquid carbon dioxide vaporizes as it enters bell through nozzles, cools parts uniformly

ments is the tinplate annealing furnace. As tall as a six-story building, this furnace continuously anneals a light-gage strip up to 48 in. wide, under closely controlled temperature and atmosphere conditions. Current strip speeds are 1000 fpm, with several units about to go into operation at 1500 fpm. Future plans call for 2000 fpm. Based on 30-in. x 0.015-in. strip, 2000 fpm is enough to make over one-half million beer cans per hour. Rough heating is by gaseous fuel burned in radiant tubes; but the last pass in the heating chamber and all the holding chambers are electrically heated to get the close temperature control required.

Still another example of progress lies in the medium-high-temperature range, where the "hump-type" mesh-belt furnace has been designed for the bright annealing, brazing, and heat treating of stainless steel without oxidation or discoloration. The heating and cooling sections have been elevated to eliminate the entrance of air, which would contaminate the dry hydrogen atmosphere. Use of new "high-purity" brick, which is not affected by the hydrogen atmosphere, has eliminated costly muffles. This has doubled the heating rate and, consequently, the production.

Moving to more exotic applications, we have the traveling bell furnace for treating rocket motor cases. These large, lightweight tanks are made of relatively light-gage metal and usually require a heat, quench, and draw treatment. As mentioned earlier, such parts pose problems of support, rapid transfer to the quench, and distortion control. This open-end-down furnace overcomes all these problems. It straddles a pit which encloses a loading area, quench tanks, and a pit-type draw furnace. A chain which passes through the top of the furnace attaches to the tank and lifts it into the furnace. During heating, a cover closes the bottom of the furnace. At the end of the heating cycle, the furnace moves over the quench tank, the cover moves aside, and the tank is quickly lowered into the quench.

Rocket motor cases are also being treated in standard bell furnaces. They are heated in the bell, then quenched in the bell with liquid CO_2. The CO_2 vaporizes as it enters the bell through nozzles and produces very uniform cooling. With molybdenum heating elements, this type of furnace can operate to about 3000 F.

Vacuum arc melting furnace

Without the vacuum arc melting furnace, the production of the rare metals in any significant quantities would be extremely difficult. This furnace resembles a giant arc welding machine. An electrode of the material to be melted is suspended from an electrode holder within the furnace housing. The lower part of the furnace is a copper-lined, water-cooled crucible. An arc is struck between the lower end of the electrode and material in the bottom of the crucible. The electrode melts progressively and is deposited in the crucible. Tantalum (melting point 5432 F) is melted in this kind of furnace.

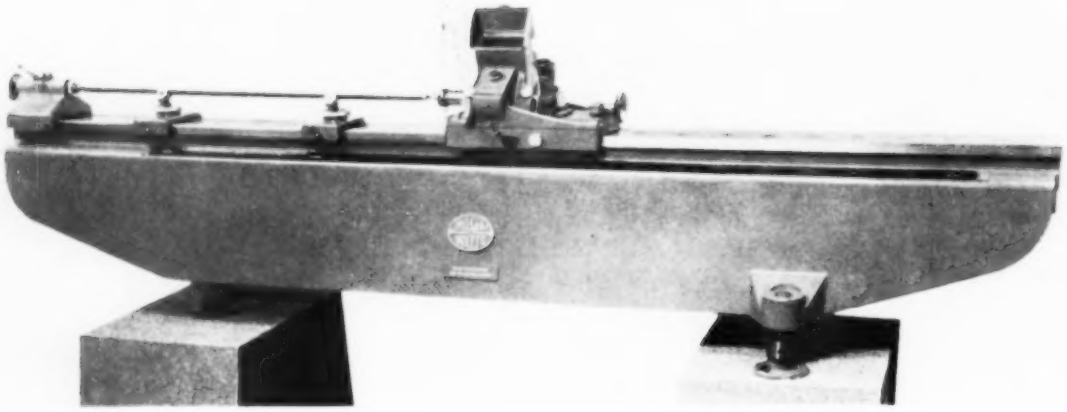
Metal produced by the vacuum arc process is highly purified, with remaining traces of impurities so finely divided and uniformly distributed that there can be no localized segregation to cause faults in the ingot. Such high-purity alloy steels are in demand for highly stressed reactor parts and high-speed shafts. Though first used for rare metals, the vacuum arc's tonnage production will be of the more common alloys.

The radiant-shield furnace, also called the cold-wall furnace, was developed to attain the high temperatures necessary for forming and heat treating the rare metals. Because there is no refractory, high vacuum and high heating and cooling rates can be attained.

Heat generated in the heating chamber is reflected back to that area by the shields, or baffles. High temperatures can be achieved because the heating elements and baffles are made of rare metals.

Solutions create problems

Many problems have been solved through electric furnaces. But each solution seems to bring on another problem. Thus, we see no end to the evolution of the electric furnace.



Smaller model . . .
Watts Type A machine has a measuring capacity of 80 or 120 in. as desired; the larger model Type B will handle work up to 30 ft.

How to measure long pin gages

Interchangeable manufacture of large workpieces to ±0.000,05 or ±0.0001 in. per ft requires a more accurate means of measuring the pin gages themselves. Here is a British development* that enables such measurements for gages up to 30 ft long

Things are changing in the machining of large workpieces. "Match fitting" has been the way the boring-mill or large-lathe operator obtains the desired clearance or interference between pairs of mating parts. He relies upon pin gages for checking internal diameters up to 30 ft. and he uses pin gages to set trammels for checking outside diameters.

Match fitting is satisfactory when all measurements on original work and repair jobs are handled in the same plant. However, today, repair parts may be made elsewhere for large machines, or fixtures may have to be set up in the field and certified. Therefore, the trend is to work to definite limits on parts of large dimensions.

Because of the need for interchangeability on large parts the International Standards Organization has extended tables of limits and fits to workpieces up to 200 in. in dia. Certainly, in the cases of ISO Tolerance Grades IT, 7, 8, and 9, it is desirable to be able to measure the pin gages to one-tenth of the tolerance on the workpiece, or in the order of ±0.00005 or ±0.0001 in., as the case may be.

Measurement of pin gages by comparison with standard length gages is inconvenient for lengths greater than 4 to 5 ft. Therefore, Hilger & Watts have developed machines that are capable of such measurements up to 30 ft. These machines incorporate calibrated scales or tapes, and should be used in either a temperature-controlled room or in a plant area free of drafts and rapid temperature changes.

There are two types of these long-length measuring machines:

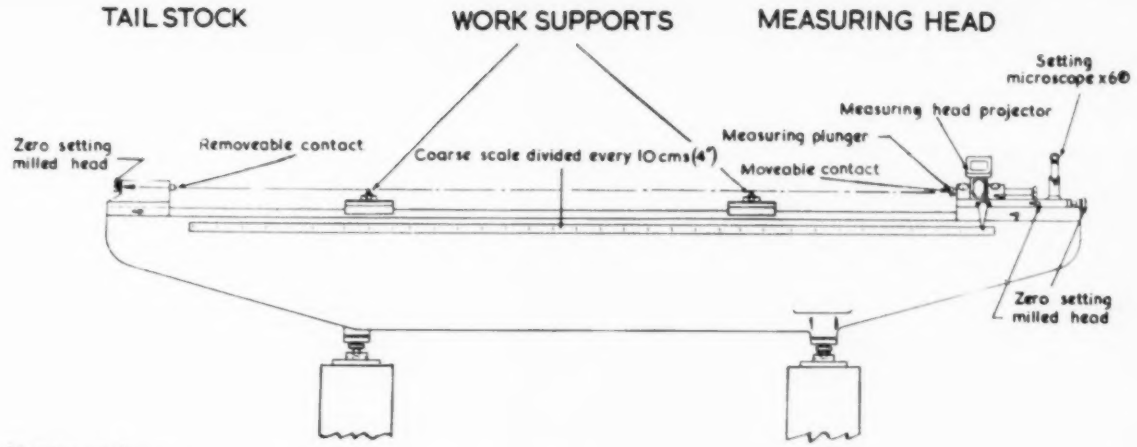
Type A (illustrated) is made in two measuring capacities—80 or 120 in.—and reads direct to 0.00005 in. if fitted with the Type A headstock and to 0.0001 in. if supplied with the Type B headstock. This type of machine has an H-section master scale within the bed, and is furnished with 4-in. graduations.

The Type B machine is formed by placing two or three unit beds end to end to provide measuring capacities of 19 ft and 29 ft 6 in. respectively. This version reads directly to 0.0001 in. Here, the main basis of measurement consists of a steel tape graduated at 4-in. intervals.

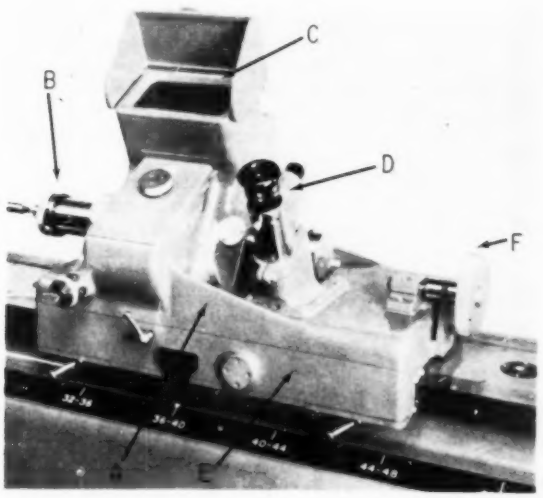
These machines are fitted with tailstocks and headstocks, the latter incorporating the scales and optical systems to make the measurements to the accuracies cited. The Type A headstock (illustrated) has a main casting *A* that carries a measuring plunger *B*, the projection screen *C* and the setting microscope *D*. It is itself mounted on a sole-plate *E* which can be slid to any desired position along the bed of the machine and clamped to it by means of levers. A slow-motion screw, operated by the milled head *F*, provides a fine longitudinal adjustment for the main casting on its sole-plate. A lever enables the main casting to be finally clamped to the sole-plate and thus the bed.

To measure the length of a gage, the headstock and tailstock are first set in the zero position. To do this, the headstock is moved left on the bed with its microscope set exactly over the zero line of the master scale. The tailstock is then moved up to it, so that the two contact faces are brought together. The reading of the measuring plunger is adjusted to read zero. Having then clamped the tailstock in this zero position, the headstock is moved along the bed for locating it over the particular line on the master scale which is just short of the length of the gage

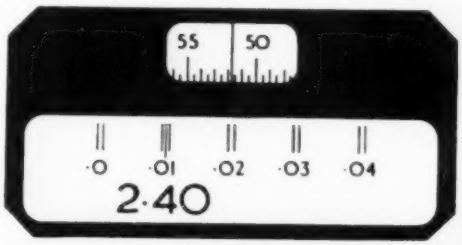
*Reported by F. H. Rolt, C. Godfrey and S. C. Bottomley recently before the International Institution for Production Engineering Research, London. The equipment is built by Hilger & Watts Ltd, London, which is represented in the U. S. by Engis Equipment Co, Chicago.



Master scale . . .
on the Type A machine is an H-section housed within the bed. Graduations at 4-in. intervals are ruled on hardened steel buttons

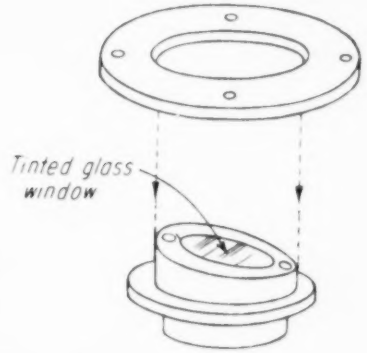


Microscope *D* . . .
serves to position the casting *A* in relation to any of the 4-in. graduations on the master scale. Measuring plunger *B* has a precision 4-in. scale graduated to 0.05 in. By a projection system and "optical micrometer," readings can be obtained to 0.00005 or 0.0001 in., according to the magnification system used in the head, Type A or Type B



Typical reading of plunger . . .
Image of scale line 2.40 is set between fiducial lines corresponding to 0.01, and the reading of the optical micrometer is 0.00518. Thus the complete reading is:

Main scale	=	2.40
Graticule	=	0.01
Micrometer	=	0.00518
		2.41518

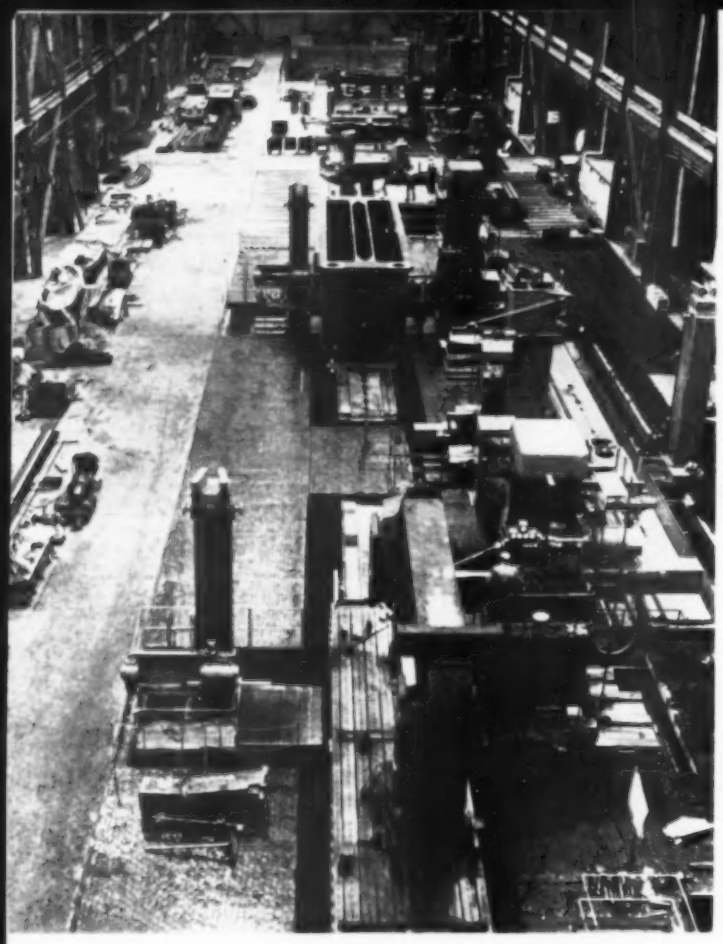


Optical compensators . . .
(prism windows) are positively set to length standards of highest precision. This avoids the necessity of using calibrations, and provides a positive setting to the 4-in. scale of the measuring plunger

to be measured. With the headstock clamped in that position, its measuring plunger is withdrawn to the right, the gage placed in position and the plunger moved up to it so that the gage is held between the two contact faces. The reading of the measuring plunger is then taken. The length of the gage is determined by adding this reading to the length of the master scale representing the distance between the tailstock and the headstock.

Measuring plunger *B* carries a 4-in. glass precision scale graduated at 0.05 in. intervals. Each scale line is numbered. By optical means the image of a scale line is projected onto a screen. The position of this image is read in reference to a scale on the screen representing hundreds of an inch over a range of 0.05 in. Marks on the screen scale consist of similar pairs of parallel lines to serve as fiducial marks.

To take a reading, the projected image is set symmetrically between a pair of these fiducial marks by means of an optical micrometer. The micrometer reads in 0.0005 or 0.0001-in. increments. One sketch above shows how readings of the master scale, the optical screen reading and the optical-micrometer reading are added to find the length of the gage.



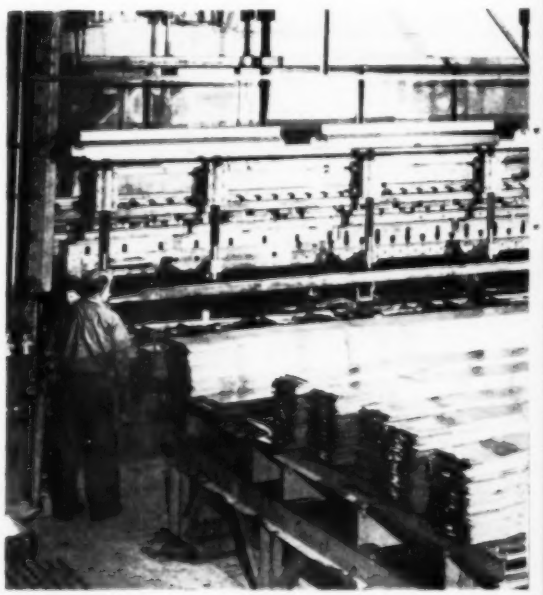
Spacious layout . . .
of Danly's new machining bay allows easy transfer of large workpieces with 50 and 100-ton overhead cranes.

Expanded shop

With the right facilities, you can make even the biggest machining jobs a series of normal production operations. With that view in mind, Danly Machine Specialties recently added two 500-ft bays onto its Chicago plant. Result? The company can now machine any mechanical part capable of shipment on a flatcar—without special setups.

Here's an example of what the expanded shop has made possible. Danly has long been a prime supplier of large mechanical presses. When A O Smith Co wanted someone to build a huge press for its Milwaukee plant, Danly was a logical choice. But what A O Smith had in mind was no ordinary press. It had to have a capacity of 4000 tons, and it had to be large enough to stamp out 40-ft side members for heavy duty truck frames. Assembled, it would be one of the biggest mechanical presses ever built in this country.

Here were the specifications: 60 x 480-in. bed; 42 x 480-in. slide; 48-in. shut height; and 22-in. stroke. The



Weighing in at over 750,000 lbs . . .
the big slide, crown and upright assembly towers 30 ft over workmen as they ready it for testing in one of Danly's 20-ft-deep assembly pits

speeds construction of giant press

press would have to operate at 10 strokes per minute. To build it would require 2 million pounds of steel.

How do you build a press that has a 300,000-lb slide, a 280,000-lb bed and a 252,000-lb crown? It's the kind of job that few machine shops in the country could tackle.

Building the big press gave Danly a chance to put its enlarged production center to its first real test. The new extension on the Danly shops consists of two parallel bays, each over 500 ft long. One bay is a 94-ft-wide machining area (see photo) that has five horizontal boring, drilling and milling machines (7-in. spindle), and two 9-ft-arm radial drills. The other bay is an assembly and shipping area with two 40 x 80-ft assembly pits, each 20 ft deep, plus four floor-level railroad tracks that can hold nine flatcars indoors. Each of the new bays is served by one 100-ton and several 50-ton overhead bridge cranes.

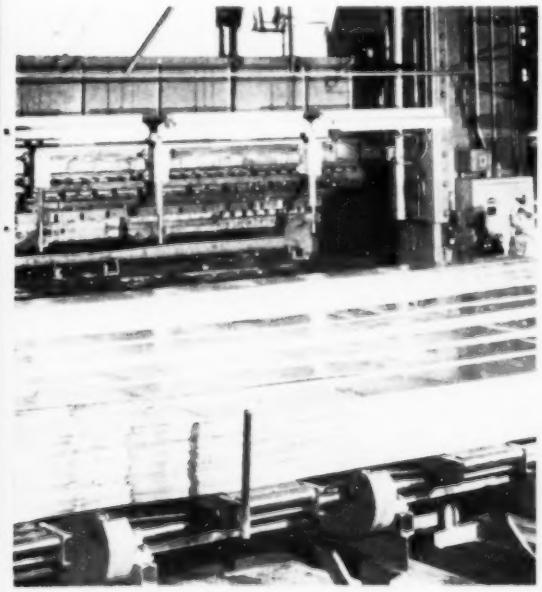
In the new assembly bay, Danly has built ledges alongside both of the 20-ft-deep assembly pits. When it wants to test a line of presses for mass-production stamping operations, the company simply spans the pit with support beams and sets up the presses as they will be used.

Building the press was no simple task; from start to finish the job took eight months. Danly employees worked three shifts a day during that time, as they torch cut, welded, machined, assembled and tested the 4000-ton capacity press. Thanks to its new facilities, the plant could use conventional machining techniques despite the size of the parts.

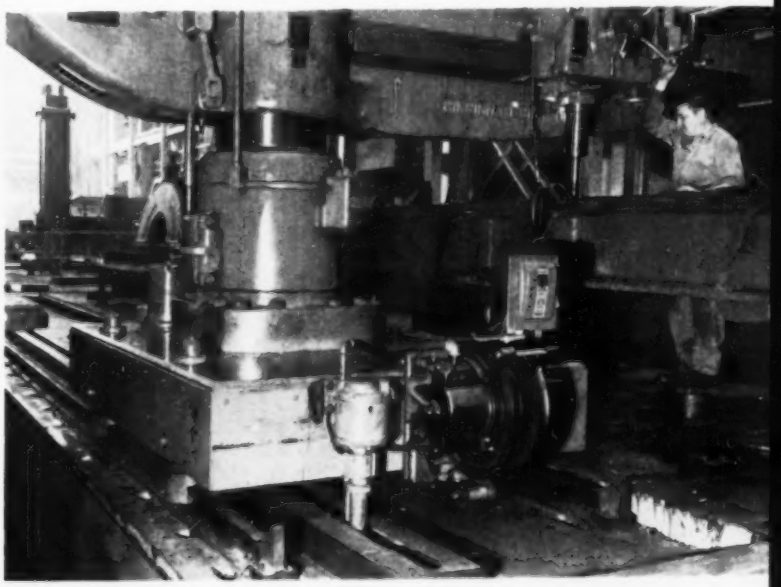
Danly faced an interesting problem during the welding operations. Severe cooling stresses were generated within the metal when the massive steel sections were welded together to make the press components. To avoid cracking, all sections of the press had to be stress relieved in Danly's furnaces. All, that is, except the huge bed. It had to make two trips to Milwaukee for stress relieving—it was too big for Danly's furnaces to handle.

The problem, of course, was to prevent the bed from cracking during shipment in the cold November air. As workmen welded the bed, they covered each section with insulation. Then the finished weldment was surrounded by steam lines and lifted aboard a flatcar for the trip to the stress-relieving furnace in Milwaukee. Even though the bed was shipped during a cold spell, steam lines surrounding the weldment, and fed from an auxiliary boiler in the locomotive, kept it at a safe 70 F. In Milwaukee the bed was stress relieved inside a big furnace ordinarily used to glass-line huge beer processing tanks.

Of course, the completed press was too large to ship as a unit. In all, 13 flatcars were loaded inside the assembly bay to carry the various subassemblies to the customer's plant in Milwaukee. To simplify assembly in the A O Smith plant there, the press was assembled and tested in two units. The bed assembly went first so it could be mounted on its foundation, then the crown, side and upright were delivered.

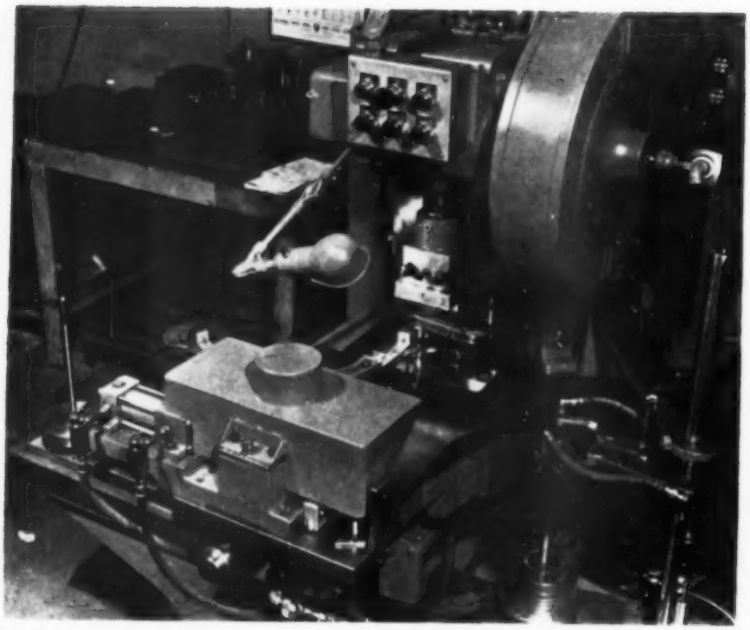


▲ **This huge Danly press . . .** easily forms truck-frame side members up to 40 ft long in A O Smith's Milwaukee plant. More than half of the press is below floor level

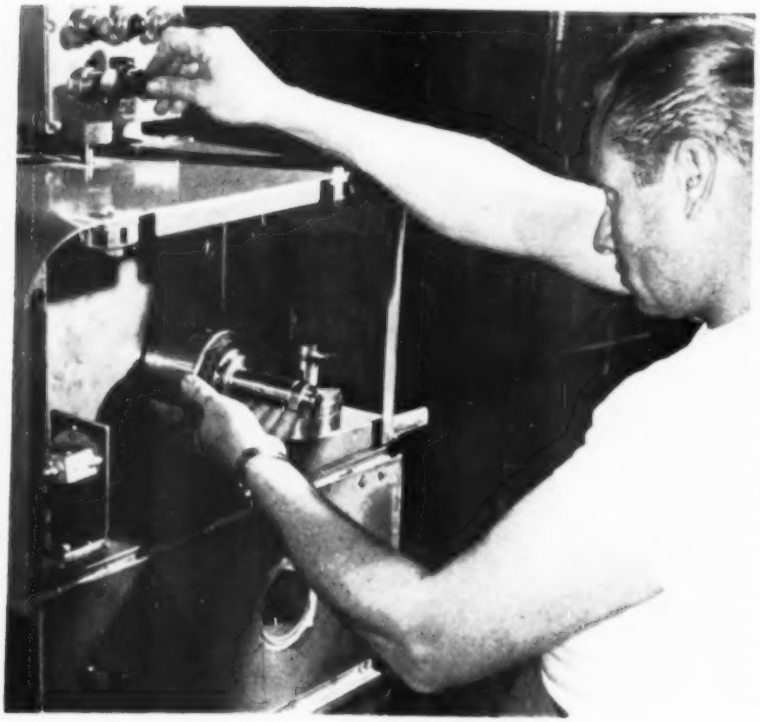


Cutting fluid . . . is furnished to spindles of traveling-column radials and horizontal-bar machines by individual pumps submerged in troughs kept filled by pumps in sump at bottom of pits. Floorplates beside machines drain coolant to sumps

High-volume setups pay off in



Mechanized notching press . . .
Expensive lamination dies are eliminated by adjustable indexing dies. Rotors and stators are loaded on spindles in foreground. Then air-operated arms transfer them to oscillating magnetic arms that load the die. Parts are indexed by keyway. Second magnetic arm unloads parts to a rack. Dies are adjustable for various lamination OD's



"Universal" slotting machine . . .
Resistance rings for special squirrel-cage motors are slotted by a carbide saw. Rings are clamped on arbor while head moves them past cutter. Stroke is adjustable so rings of any thickness can be cut. Door closure starts automatic cycle

By George H DeGroat, Detroit editor

Standard component designs make it possible for the Small Motor division of Westinghouse Electric Corp, Lima, Ohio, to operate special high-production machines even though products of the Aircraft Equipment Department are ordered in small lots. In spite of requirements for machine versatility, the department has everything from home-made setups to special transfer machines.

Motors, generators, and other aircraft apparatus are produced in small quantities; but many of the components for these products are standardized. For example, mounting-end frames, shafts, and master fins are identical on four different motor sizes—a typical size being a 7½-hp ac motor for flap actuators on the Boeing 707 jetliner. Total quantities of motors are small, but quantities of frames, shafts, and fins are large enough to justify special high-production equipment.

One setup designed for maximum versatility produces slots of any required thickness in copper resistance rings. The rings go into squirrel-cage motors. Stamping these rings with the slots in them would make die costs high and would be difficult because of their relatively great thickness. In this setup, a reciprocating head with a carbide saw produces the slots as the rings index under it. The operation is completely automatic after an operator loads the rings on the indexing table and closes a guard door. About 100 slots per minute are produced, depending upon the characteristics of the particular part.

For high-volume production in the company's Industrial Motor Dept a special Sundstrand dual-spindle machine was installed for facing, boring, and chamfering partially assembled stator frames. These vary as much as 1/32 in. or more in length and are faced to maintain ±0.005 in.

low-volume production

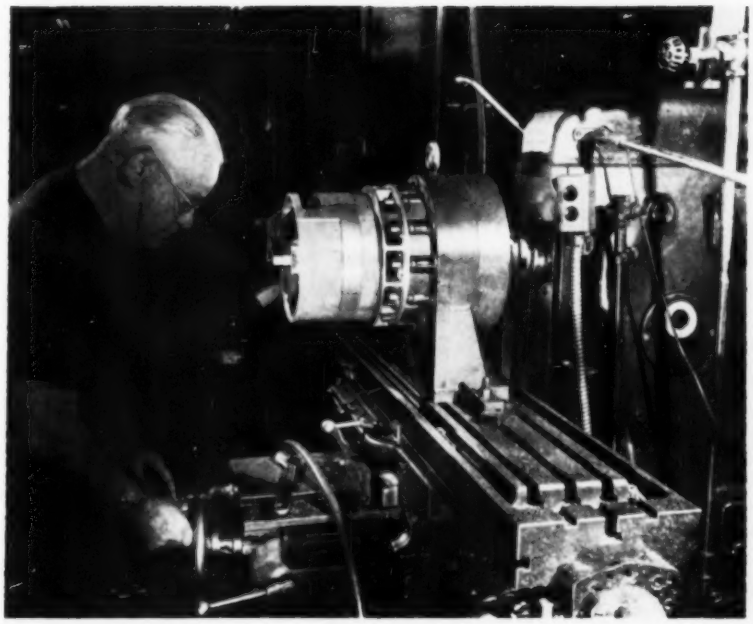
Material is 0.130-in. seam-welded 1010 steel. With two spindles on the machine, an operator loads one while the other is working.

Facing and boring are done simultaneously. But before this happens, hydraulically operated locating pins, set at an angle, engage the front end of a frame to determine the total amount of material to be removed. They actually control the travel of the rear carriage of the machine—and provide for the removal of 0.005 in. or so from the front end first. The balance to be removed is taken from the opposite end. This cut is established when the frame is reversed and the front end serves as a reference plane. Boring is held as close as ±0.002 in. on 6½-in. diameters. When the proper depth is reached, the chamfering tool is energized to produce a 45° x 1/64-in. angle on the face of the bore.

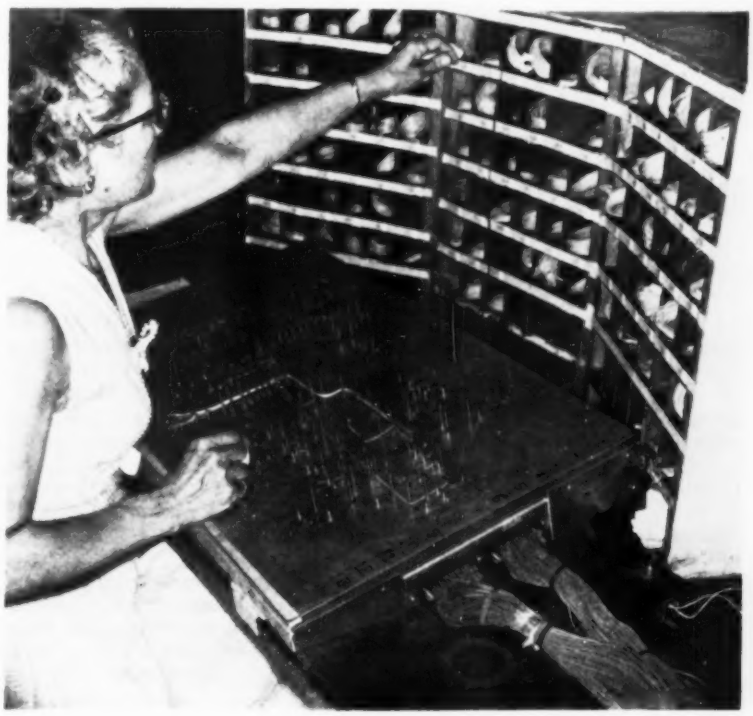
Proper timing is essential to eliminate chatter and tool wear. In fact, the chamfering tool is engaged for not more than one second while the boring tool is idle.

When the boring tool reaches the specified depth, the chamfering tool engages immediately to prevent distortion resulting from the elasticity of the material. To accomplish this "split-second" sequencing, the machine cycle is time-controlled, and even the viscosity of the hydraulic oil is controlled to insure a uniform rate of movement in the machine elements. A temperature of 140 F is maintained within 20° by means of immersion heaters in the oil reservoir.

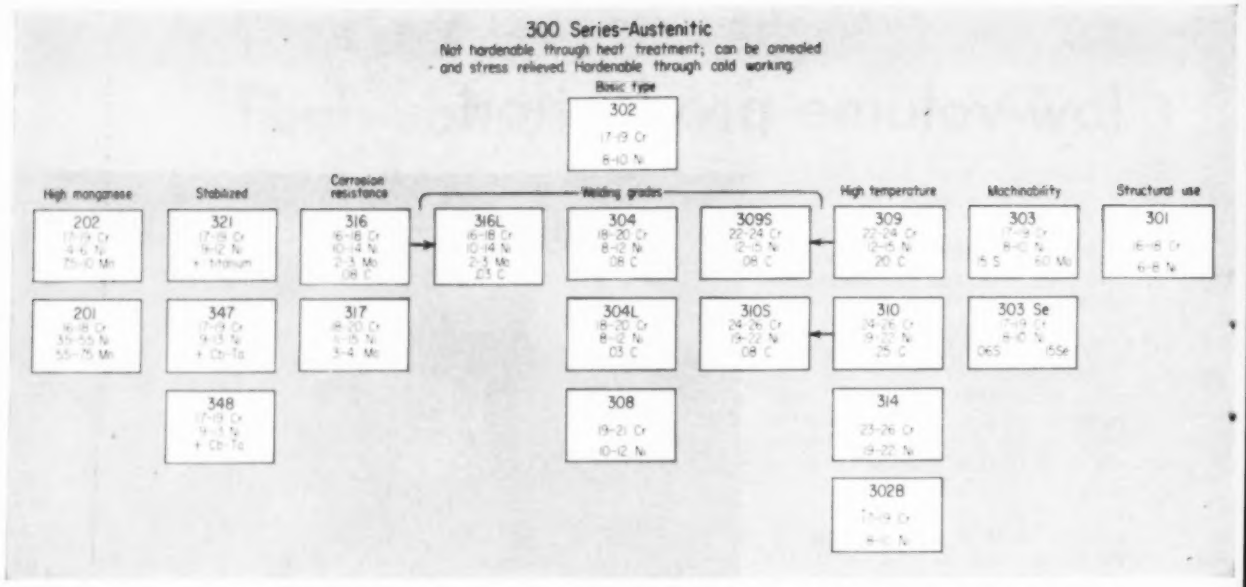
Other high-volume setups (see pictures) are paying off in the plant's low-volume production: a mechanized notching press, a twelve-spindle miller, and a unique method for wire-harness assembly. Because so many motor components are now standardized in design, these special tools are economical, even though the plant's output is relatively low.



Twelve-spindle miller . . .
"Button-hole" slots in aircraft generator frames are spotfaced and drilled from the rear on a Cincinnati miller equipped with planetary gear drive to 12 carbide cutters. Depth of feed and hole centerdistances are held to 0.005 in. (non-accumulative on centerdistances)



Wire-harness assembly . . .
Neon lights under wiring board illuminate numbered holes in sequence so operator doesn't have to memorize or keep referring to wiring diagram. Wires are laid between guide pins



The stainless steel family . . . is made up of the austenitic, martensitic, and ferritic grades, and the recently added precipitation-hardening grades. The lat-

The right heat treatment

Heat treatment of stainless steel grows more important and more critical, for an increasing amount of stainless is being used in assemblies that are highly stressed, or exposed to high temperatures or corrosive conditions. Also, many of today's fabricating techniques call for in-process heating or heat treatment.

Stainless steels are heat treated by techniques common to other ferrous alloys. However, all stainless steel types are not alike in their response to heat treatment. Some types can be hardened and tempered; some cannot. And, when stainless is specified for corrosion resistance, the effect of heat treatment on resistance to corrosion must be considered carefully.

Groups of stainless

The three major groups of stainless steel exhibit widely different characteristics in relation to heat treatment. Austenitic types (200 and 300 series) cannot be hardened by heating. They do harden by cold work. Thermal treatment is confined to full-solution annealing and stress relieving, treatments which are often essential when maximum corrosion resistance or ductility is required. Ferritic types (400 series) are not hardenable by heat treatment or cold working, though stresses built up in fabrication can be reduced by annealing. Martensitic types (400 series) can be fully hardened and tempered by heat treating. These types offer broad possibilities for applications requiring a combination of good fabrication properties, high strength, and corrosion resistance. Typical parts are shafts, gears, gaskets, cutting devices, and wearing surfaces. The introduction of the PH grades (precipitation hardening) has added a new series of fully hardenable alloys.

Cold treatment is often used on stainless steel parts to insure greater hardness and dimensional stability. Cooling the parts to well below zero transforms any remaining austenite to martensite. Such treatment can be applied to all hardenable grades except the PH grades.

Martensitic types

A high percentage of martensitic stainless is supplied to fabricators in bar form for machined parts. Usally, it is furnished by mills or warehouses in an annealed condition for best machinability.

These types develop their maximum corrosion resistance at maximum hardness obtained by full heat

Annealing Martensitic Stainless

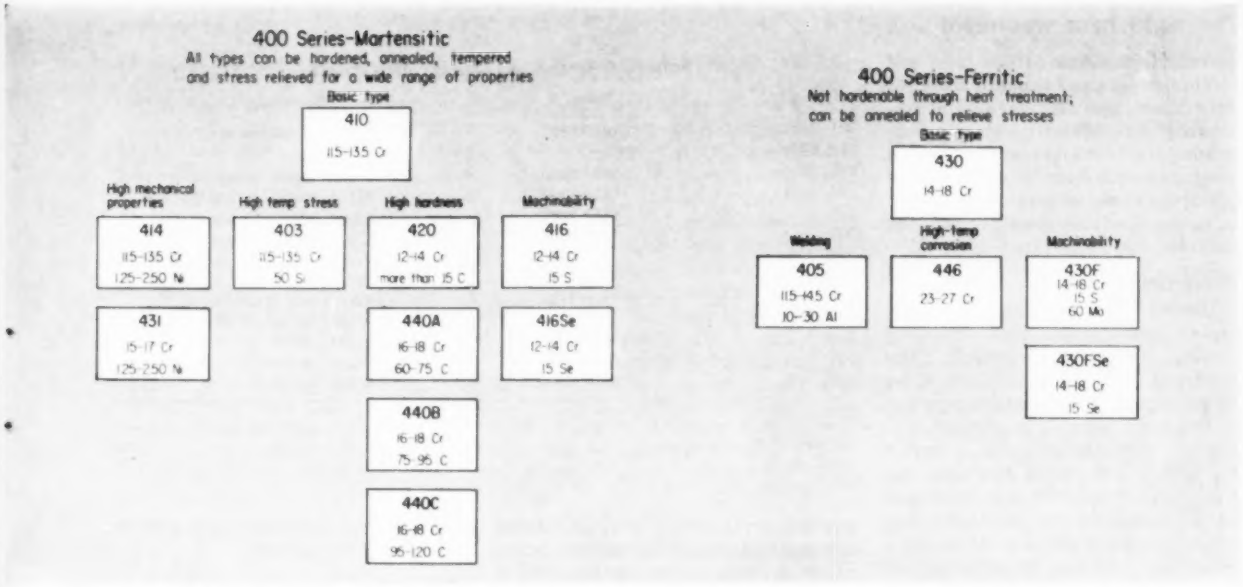
Process Anneal

Type	Temp, F	Time, hr	Cooling
403, 410			
416, 416Se	1350-1450	1-2	Air
414	1200-1275	5-7	Air
420	1375-1425	2-5	Air
431	1150-1225	5-7	Air
440A, B, C	1350-1450	2-5	Air

Full Anneal

Type	Temp, F	Hardness, Rockwell B
403, 410		
416, 416Se	1550-1650	75-80
414	Not practical; process anneal will soften to 100	
420	1600-1650	85-90
431	Not practical; process anneal will soften to 100	
440A, B, C	1600-1650	95-97

Note: Time at temperature—1 hr/in.; cool at 25-50 F per hour.



ter series is described in detail in the text. Of the 50 or more stainless alloys, three basic types fulfill the requirements of 50% of all applications. These are: type 302, type 410, and type 430. Eleven grades account for 85% of all stainless steel production.

keeps it stainless

By Charles W. Sherman, technical director, Stainless and Strip Div, Jones & Laughlin Steel Corp, Detroit

treatment. When greater toughness or high dimensional stability is needed, the material is tempered, often with some reduction in corrosion resistance.

Annealing

The martensitic types will harden if they are not slow-cooled after welding or hot forming at temperatures exceeding 1500-1600 F. If uncontrolled cooling cannot be avoided and part must be soft and ductile for subsequent operations, it must be annealed. For a full anneal to restore maximum softness, the part is heated to 1550-1675 F, depending on type, and held long enough to insure thorough heating, usually about 1½ hours per inch of thickness. The work is then furnace cooled at a rate not exceeding 25-50 F per hour to 1100 F. Below this temperature it can be cooled in air.

For process annealing when full softness is not needed, the work can be heated to 1150-1450 F, depending on type, and cooled in air.

Hardening

For full hardening, martensitic types require heating to 1700-1950 F then quenching in oil or air cooling. To avoid cracking, the work should be brought up to temperature slowly. For example, small parts are heated to about 1450 F, held at this temperature until uniformly heated and then raised rapidly to the full hardening range. It is advisable to add another soaking period at about 1000 F for large complicated pieces.

Excessive time at the hardening temperature is uneconomical, and may result in grain growth which causes brittleness. Usually one hour per inch of thickness is sufficient, but experimentation can often reduce time at temperature. Since most stainless parts are much less than one inch thick, time cycles are usually measured in minutes. For a piece 1/16 in. thick, time at temperature would be about 4 minutes; for ⅛ in., about 8 minutes.

Annealing for stress relief

If hardened parts are not to be tempered, they must be given a low-temperature treatment for stress relief. Parts should be heated to 325-700 F for 1 to 3 hours. The rate of cooling is not critical; parts are usually cooled in still air. Hardness will be reduced only slightly from the

Hardening Temperatures for Martensitic Stainless

Type	Hardening Temp, F
410, 403	
416, 416Se	1750-1850
414	1800-1900
431	1800-1950
420	1800-1900
440A	1825-1925
440B	1825-1950
440C	1850-1950

Stress Relieving Hardened Martensitic Stainless

Type	Temp, F	Time, hr	Hardness, Brinnell
410, 403			
416, 416Se	450-700	1½-3	330-370
414, 431	450-700	1½-3	350-390
420	325-700	1-2	440-510
440A	325-700	1-2	490-550
440B	325-700	1-2	495-555
440C	325-700	1-2	510-650

Note: Use low temperatures and short time for greater hardness and corrosion resistance; high temperatures and long time for ductility and toughness.

quenched condition if the high end of the temperature range is used for short times, and the removal of unbalanced stresses will improve elongation and toughness. Greatest toughness or impact strength is obtained by using mid-range temperatures for medium time periods, for example, 550 F for 1½ hours.

Tempering

Tempering, or drawing, requires higher temperatures than stress relieving, usually 1050-1400 F. (The intermediate range of 750-1000 F, between stress relieving and tempering, is not used because it impairs corrosion resistance and impact strength.) Tempering increases ductility and toughness but decreases hardness, tensile and yield strengths, and corrosion resistance. As in stress relieving, selection of temperatures and holding period is critical.

Austenitic types

As we mentioned earlier, austenitic stainless steels are heat treated to (1) relieve stresses and restore softness and (2) increase corrosion resistance. When unstabilized austenitic stainless steels ("18-8" types) are raised to 800-1600 F during fabrication, chromium carbides may form along grain boundaries and reduce corrosion resistance. To dissolve the carbides and put chromium and carbon back into solid solution, the workpiece must then be solution annealed.

This requires slow heating to 800 F (to reduce internal stress), rapid heating from 800 to 1600 F (to eliminate further carbide precipitation), and then to 1850-2150 F, depending on stainless type. The work is held at the annealing temperature long enough for complete soaking, usually about 30 minutes per inch of thickness. It is then quenched as rapidly as possible to below 800 F and then cooled to room temperature in air.

Stabilized grades

Harmful carbide precipitation and the necessity for solution annealing may be avoided by the use of stabilized grades in the 300 series (309-SCb, 318, 321, 347, 347FSe and 348). Small amounts of titanium, columbium, or tantalum, which form carbides more readily than chromium, are added to these types. Carbides of these three metals do not form solely along grain boundaries but are well dispersed.

The stabilized grades can be used for continuous service in this sensitizing range. Furthermore, if appreciable levels of internal stress are reached during fabrication, parts made of these grades can be given a stress relief anneal at lower temperatures (up to 1600 F) and need not be quenched. This is an important factor in the fabrication of complex parts which might be subject to considerable distortion during the drastic solution-annealing treatment.

Solution Annealing Austenitic Stainless

Type	Temp, F	Quench
301	1950-2100	Rapid. Water or air.
302, 302B		
303, 303Se	1900-2050	Rapid. Water or air.
304, 304L	1850-2050	Rapid. Water or air.
305	1850-2000	Rapid. Water or air.
308	1850-2050	Rapid. Water or air.
309, 310	1950-2100	Very rapid. Water or air.
309S	1900-2050	Very rapid. Water or air.
310S	1900-2100	Very rapid. Water or air.
314, 316, 317	1950-2100	Rapid. Water or air.
316L	1900-2050	Rapid. Water or air.
321	1750-1950	Water or air.
347, 348	1800-2000	Water or air.

Notes: Time at temperature—30 min in high side of range; low side somewhat shorter. Rockwell hardness B 85 max obtained in all types except 304L, 305 and 308 (80). Air cooling permissible only with thin gages or small sections. As a guide, cool from annealing temperatures to 800 F in 3 min on unstabilized grades (all but 321, 347, 348).

Extra-low-carbon grades

Another means of reducing carbide precipitation is the use of low-carbon types such as 304L and 316L. In these grades, chromium carbides form more slowly than in the higher carbon grades because the amount of carbon available to form carbides is limited. As a result, extra-low-carbon grades can usually be welded without precipitation and can be stress relief annealed and slow cooled. If they are held in the sensitizing range for more than about 2 hours, carbide precipitation may take place, hence they cannot be used for parts normally subjected to 800-1600 F in service.

Stress-relief annealing

Stainless steels of the 200 and 300 series are frequently heat treated to reduce internal stresses produced by work hardening when maximum ductility is required. In the case of unstabilized grades, parts must be annealed at temperatures below 800 F if carbide precipitation is to be avoided. This necessitates the use of very long times at temperature, in some cases up to 36 hours.

Stress relieving is often employed between fabricating operations such as multiple forming. When full softness is required for severe operations such as deep drawing and spinning, it may be most economical to stress relieve in the carbide-precipitation range. Acid pickling must be avoided at this point. After final forming it would then be necessary to use a solution anneal for maximum corrosion resistance.

Ferritic types

Although the ferritic grades cannot be hardened by heat treatment, they can be annealed to regain ductility, softness, and to relieve stresses. In addition, weldments are sometimes annealed (1450-1550 F) to improve corrosion resistance in the weld since these grades are subject to carbide precipitation.

Annealing for either corrosion resistance or stress relief requires heating to 1200-1650 F followed by air cooling or quenching. Since grain growth is a characteristic of the ferritic group at temperatures above 1650 F, operations at or above this temperature should be performed as rapidly as possible to avoid excessive brittleness. It is important to observe this limitation when heat is applied during fabrication, as in welding and hot forming.

Annealing Ferritic Stainless

Type	Temp, F	Cooling	Hardness, Rockwell B
405	1350-1500	Air	75
430, 430F, 430FSe	1400-1500	Air	80
446	1550-1650	Water quench, preferred	83

Time at temperature—1-2 hours.

Precipitation-hardening grades

The precipitation - hardening grades of stainless steel are relatively new and still the subject of intensive research. Each application of the PH grades should be carefully studied to develop the processing schedule best suited from the standpoint of easier fabrication and optimum mechanical properties in the finished part. For this reason, what follows is only a general guide to the heat treatment of PH alloys; detailed presentation of the various theories that have been advanced to explain the transformation and precipitation-hardening phases would occupy more space than is warranted in an article dealing with heat treatment of stainless steels as a whole.

17-4 PH

17-4 PH, when solution treated at 1900 F and cooled, is similar to a low-carbon martensitic stainless steel with an ultimate tensile strength of 150,000 psi. Transformation from austenite to martensite begins to take place as the metal cools to 270 F, and is essentially complete when the temperature reaches 90 F. In this condition, 17-4 PH can be machined and welded without great difficulty.

For forging billets and bars, this material can be supplied in the over-aged condition (1150 F for 1 to 4 hr). It is then soft enough for cold sawing and ductile enough for moderate cold forming.

Solution heat treatment at 1900 F and cooling to 90 F, followed by precipitation hardening at 900-1100 F and air cooling will yield high tensile properties. Holding a final temperature of 900 F for one hour yields a tensile strength of 195,000 and good ductility. Higher temperatures (to 1150 F) will increase ductility but will lower the tensile strength

Uniform heating and controlled cooling is of great importance. High internal stresses are likely to develop and internal cracking will result if care is not taken. There is a predictable contraction of 0.004-0.006 inches per inch which will occur during the final aging treatment. If close tolerances are necessary, however, compensation may be made during final machining.

PH 15-7 Mo and 17-7 PH

PH 15-7 Mo and 17-7 PH are basically austenitic in structure. Depending on the desired results, they can be hardened in several ways. Following a solution anneal at 1950 F, they can be transformed to martensite by heating to 1400 F and cooling to 60 F, or by heating to 1750 F and cooling to —100 F; the exact martensitic transformation temperature being dependent upon the temperature used for the conditioning anneal. Aging, or precipitation hardening, is then accomplished at 1050 F or 950 F, respectively. A third method of treating these steels includes transformation of the material at the mill by cold rolling 60% and then aging for 60 minutes at 900 F. This method develops a product with a tensile strength of about 265,000 psi, compared to approximately 210,000 and 240,000 psi, respectively, for the two other methods. Fabricability is somewhat limited in this condition.

Variations in the heat treatment of all PH alloys produce variations in the mechanical properties of the final product. For instance, material aged at 950 F is stronger but less ductile than that aged at 1050 F. In general, ductility increases with the temperature and duration of heat treatment during conditioning and aging but with a resulting loss in strength.

As is the case with 17-4 PH, high internal stresses may cause cracking if both heating and cooling are not carefully controlled. During transformation, expansion of about 0.0045 inches per inch will take place. This will be followed by a 0.0005 inches per inch contraction during the precipitation-hardening phase.

Air is a satisfactory atmosphere for annealing and heat treating, but bright annealing may be done in hydrogen, argon or helium atmospheres. Unless a vacuum furnace is used, some scale and tarnish will appear, but this can usually be easily removed.

Fabricating with heat

Although the application of heat is usually associated with specific heat treatments such as annealing, hardening, etc, there are often times when heating during fabrication must be considered. The following are examples of how heat can be helpful or harmful in fabrication.

Mechanical cutting or shearing of thick sections of such types as 430 and 446, which tend to be brittle, may require preheating at 350-400 F to prevent edge cracking.

High-speed sawing may raise the temperature at the edge sufficiently to induce metallurgical changes similar to those caused by welding. Annealing may be required.

Hot cutting may cause metallurgical changes. Carbide precipitation in the 300 series may occur, depending upon the time at temperature. Grain growth is possible in the ferritic types.

Hot forming calls for close attention to starting and finishing temperatures. Hot forming is invariably followed by annealing. In the case of hardenable grades, this should be done before the work has cooled, to avoid cracking.

Rivets of the 300 series should be held at 1900-2100 F only long enough for uniform heat penetration. Rivets should be driven and headed before the temperature drops below 1700 F, to avoid cracking. Because of the small mass of the rivet compared to the work joined, temperature drop through the sensitizing range will generally be fast enough to prevent carbide formation. Rivets of the ferritic series (430 and 446) should not be heated above 1500 F; grain growth and brittleness will occur.

Springs should be heat treated at low temperatures (400-800 F) to reduce the stresses set up by cold working and to improve fatigue resistance. Springs of the 300 series should not be heated above 800 F. Try different combinations of time and temperature beginning with 35 minutes at 600 F.

Tube bending at 250-400 F improves bending characteristics, increases the toughness of Types 430, 442 and 446.

Warm forming at 500-750 F minimizes scaling due to hot methods and hardening caused by cold working.

Equipment and preparation

Sensitive and accurate time and temperature controls are of utmost importance. Time at temperature is often a matter of minutes in treating thin parts and small increments in temperature can be critical.

Heating capacity of a furnace must be adequate to effect rapid heating of the 300 types through the sensitizing range (800-1600 F). Materials handling is an important factor since provision must be made to

withdraw work from the furnace and transfer it quickly to quenching tanks or other cooling equipment.

The increasing use of special furnace atmospheres such as hydrogen, ammonia, helium and argon to reduce scale and achieve a bright finish makes furnace construction important. Walls must be free of cracks, and doors must fit tightly to prevent loss of gas and contamination by air.

Furnaces should, of course, be large enough to handle parts without touching walls and to allow for adequate bracing.

In oil- or gas-fired furnaces, flames must not strike the work directly. Flames playing on a piece may cause local overheating, distortion and carburization in the area hit by the flame. Muffles should be used to prevent flame impingement.

When selecting new furnaces, manufacturers' recommendations should be sought.

Bracing for heat treatment

Large work of intricate design, such as weldments, must be carefully supported during treatment and cooling to prevent distortion. If the work is of open construction bracing is essential. Stainless steel bracing is preferred over carbon steel by many fabricators because of its high strength at elevated temperature. In addition, there is no difference in coefficient of expansion to cause distortion. If carbon steel is used for bracing, an asbestos pad should be inserted at the point of contact to prevent carbon contamination.

Bright annealing

This technique is rapidly expanding beyond the treatment of small parts, for which it was originally introduced. Parts annealed in air develop scale that must be removed by additional processing; annealing in carefully controlled atmospheres of moisture-free hydrogen or dissociated ammonia (75% hydrogen and 25% nitrogen) prevents discoloration and the formation of scale.

Both batch-type and continuous furnaces are available for bright annealing and hardening. Batch-type operation requires use of a sealed container with necessary piping to permit a continuous flow of the protective atmosphere around the parts. In continuous equipment, a protective atmosphere, usually dissociated ammonia, is maintained throughout the entire furnace chamber.

Because of the need for precise atmosphere control, fabricators may wish to consult with commercial heat treaters, many of whom offer facilities for bright annealing and bright hardening, as well as a full range of heat treating services.

Protective atmospheres are also used for stainless steel brazing, particularly in honeycomb production. A batch-type operation is used in which the assembly to be brazed is loaded in a sealed retort. The retort is placed in the brazing furnace with argon gas circulated through inlet and outlet pipes after purging.

Another widely used method of eliminating scaling, carburization or decarburization is salt-bath heat treating. Salt baths permit complete immersion of parts in a controlled medium.

Salt-bath heat treatment is not as drastic as it might appear, for when cold parts are immersed in the bath a protective "cocoon" of salt forms around the part until it reaches a temperature near that of the bath. Similarly, when parts are withdrawn from the bath a thin coating of salt prevents oxidation.

Work preparation

Another major factor is the care which must be exercised in preparing parts for heat treatment. Whenever possible, trial pieces should be run to determine optimum times and temperature prior to the heat treatment of finished parts. All work should be carefully cleaned, particularly when surface appearance is important. For example, fingerprints on bright stainless surfaces to be bright annealed will be burned into the surface and cannot be removed without polishing. Carbon steel and other carbon-bearing materials should be kept away from the surface of stainless parts since they can cause localized carburization, which has a bad effect on mechanical properties and corrosion resistance. When fast cooling is involved, it is necessary to consider the possibilities of distortion, and proper support and adequate bracing must be given careful attention.

Above all, it is essential that there be a clear understanding of the heat treatment required, to avoid errors which may require rework or replacement of a part.

Glossary of Terms

Heat treatment—An inclusive term covering the application of heat (or cold) at various temperatures, holding times, and methods of cooling to produce changes in physical condition and mechanical properties and to restore corrosion resistance. Heat treating operations include annealing, hardening, tempering, process annealing and stress relief annealing.

Austenite—A solid solution with iron as the solvent usually existing at high temperature in ferrous materials. In stainless steel, nickel suppresses the transformation of austenite, making it stable at room temperature.

Martensite—An acicular structure which results from the transformation of austenite well below the critical point. It is extremely hard and tends to be brittle unless tempered.

Ferrite—Also a solid solution with iron as the solvent but with a crystal structure differing from austenite.

Hardening—Applied to martensitic grades only. Development of hard, martensitic microstructure by heating to austenitizing temperature and quenching.

Tempering—Applied to martensitic grades only. Conducted at lower temperatures following hardening to reduce brittleness and relieve stress and transform any remaining austenite to martensite to reduce dimensional changes. Transition from austenite to martensite causes a volumetric change. For dimensional stability all austenite must be converted to martensite.

Solution or full annealing—For austenitic and ferritic grades, a high temperature treatment followed by quenching restores maximum corrosion resistance, softness and freedom from internal stresses. For martensitic grades, the high temperature treatment is followed by controlled cooling through the transformation range.

Process annealing—This is a form of stress relieving conducted at lower temperatures than full anneal, to restore the part to sufficient softness between processing steps, so that additional forming operations may be performed.

Annealing for stress relief—Lower temperature technique to relieve unbalanced or other stresses. Unstabilized austenitic grades may suffer severe impairment of corrosion resistance from stress relief. Confusion of this term with solution or full annealing must be avoided.

Stabilized groups—Refers to Types 321, 347, 348 which form harmless carbides. They contain titanium, columbium, or tantalum.

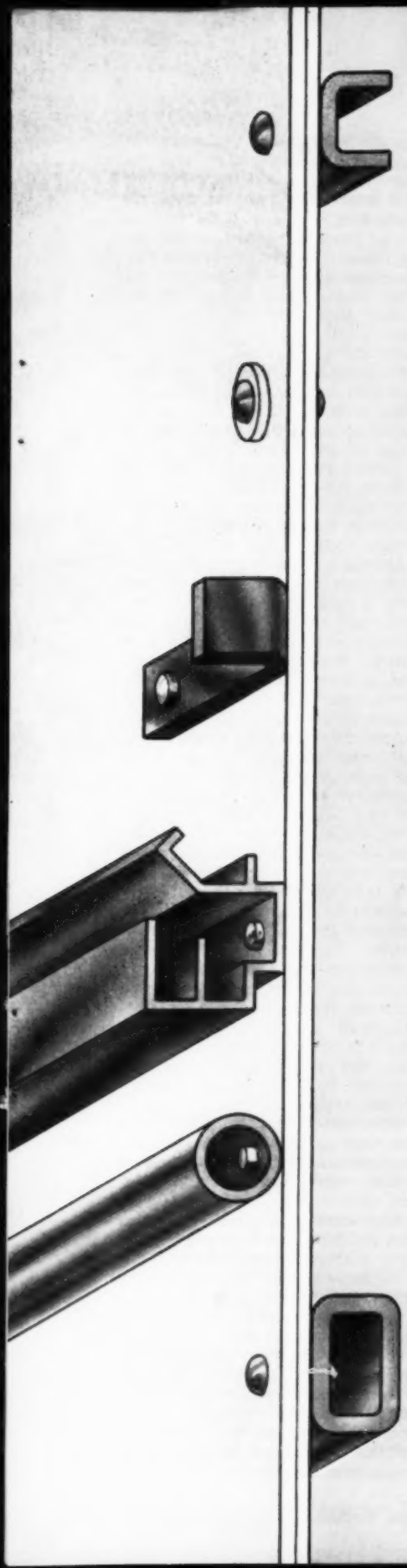
Holding Time—Length of time a part is held at annealing or hardening temperature. Varies with type, thickness, and properties desired.

Grain growth—An increase in grain size which may promote brittleness. Ferritic grades are particularly susceptible.

Sub-zero treatment—Chilling parts well below zero will usually cause transformation of all retained austenite to martensite in the heat-hardenable grades, resulting in greater hardness and improved dimensional stability.

Carbide precipitation—The formation of metallic compounds with carbon in the range 800-1600 F. Chromium carbides are harmful when formed along grain boundaries.

Sensitizing—Precipitation of carbide in the range of 800-1600 F, may impair corrosion resistance.



American Machinist
Special Report No. 478 Sept. 7, 1959

An Engineer's Guide to

Blind Riveting Practices

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Installed cost of a blind rivet is often lower than possible with other fastening methods. Tools are cheap and have high salvage value for new setups. Production rates are high. These factors may more than offset a higher cost for the blind rivet itself.

Along with low or lowest cost, you may get a cleaner-looking, more compact product or assembly. Joints can be made in any position. Handling of bulky assemblies is minimized. These are some of the reasons why manufacturers of electronic gear, transportation equipment, and consumer capital goods are increasing their consumption of blind rivets.

To answer questions about the blind rivet and its application, extensive data have been compiled for you on joint designs and joint strengths.

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Blind riveting practices . . .

Three basic methods of riveting a product are: (1) upsetting a solid rivet with a pneumatic hammer and bucking bar; (2) setting a tubular or bifurcated rivet on a bench or floor machine; or (3) blind riveting, using one of the special fasteners that have been developed by various companies. The last method has shown the fastest growth in recent years.

Millions of blind rivets are now sold annually for assembly of such products as electrical and electronic equipment, appliances, hardware, automotive products, metal furniture, and aircraft applications—to name a few. The fact is that blind riveting possesses many of the advantages of conventional riveting processes, plus several distinct and desirable ones of its own. What are they?

Blind riveting is fast . . . The speed with which a joint can be made depends on design and location, and the type of rivet and tool employed by the operator. With "Pop" rivets for example, and an air-hydraulic gun, speeds of 700 to 800 cycles per hr are not unusual.

Rivets hold well in thin sheets . . . Many fasteners require wall reinforcement to provide sufficient strength and bearing surface to prevent pull-through or loosening in service. Most rivets, on the other hand, have a relatively large projected area under the head. If the clinch is made against the surface rather than against the wall, reinforcement is seldom required.

Equipment investment is low . . . Blind rivets can be set with small, lightweight equipment. The maximum cost of a tool—even one equipped with interchangeable mandrels and various attachments for reaching into confined areas—is seldom more than a few hundred dollars and can be lower than $20 for hand tools.

Their low cost and high salvage value make blind riveting tools particularly attractive from the standpoint of capital investment, especially to the manufacturer who is faced with job-shop production of multiple items. And it is no less important to the high-production manufacturer who tools indexing tables or in-line assembly stations for automated production.

Positive joints . . . These can be made in both metallic and nonmetallic materials. Being mechanical in nature, the quality of the clinch and of a riveted joint normally can be determined by visual inspection.

With blind riveting, this is not quite the case. The clinch is inside the assembly. Visual inspection is impossible. However, the only variables in blind riveting, besides the rivet itself, are hole size and material thickness. While these remain constant or within prescribed limits (See Table 1) joint quality will be consistent.

Low joint cost . . . Many engineers overlook some of the most important elements in assembly costs. For example, there's no fastener required to make a spot-welded joint, but assembly cost may or may not be high, depending on the equipment and control overhead, cleaning, flux (if any), inspection, finishing, and power costs. Conversely, a precision screw-machine product may in itself be extremely expensive, and the cost of assembly may be high—but equipment overhead may be negligible. The point is this: Only a detailed analysis will tell which assembly method gives lowest cost.

Generally, blind riveting involves a relatively high-cost fastener, but, because of assembly speed and low equipment investment, joint cost is competitive with other methods.

Adaptability to assembly methods . . . Obvious applications frequently overshadow the fact that blind rivets can be used to assemble conventional joints. Tools are small and compact. Thus, they can reach into locations that otherwise would be inaccessible. Also, the tools can be moved readily from station to station.

There are other considerations, but the last one cited becomes the overriding consideration where the assembly is large, awkward, or too heavy to position on a standard riveting machine. Many assemblies fall into this category, even the chassis for industrial TV receivers and other types of electronic gear. While, the cost of the fastener may be two or three times that of a standard rivet or screw, the in-place cost is less because of the speed of assembly.

These are the salient advantages of riveting in general and blind riveting in particular. There are, of course, others such as: (1) the ability to make the joint regardless of its location—overhead, vertical, or in the normal position, (2) the ease of operator training, (3) the ability to join multiple parts or fasten several wall thicknesses with a single rivet, and (4) the advantages of special features of different types of rivets.

Limitations . . . As with any assembly procedure, however, there are several limitations that should be kept in mind:

For one, any rivet has limited strength in tension. A tensional force applied between the rivet and the assembly may loosen the clinch or, as is more likely, tear out the wall. While this is seldom a factor in a riveted assembly, it does account for the reason that a rivet is generally recommended for compression or shear loading and infrequently for loads in tension or subject to vibration.

On the other hand, whether a rivet is satisfactory under vibration or impact depends on the manner by which it is set. If the work is not tightly clamped when the clinch is made, it will resonate and loosen in service. If compression is applied to force the work together, or if the rivet pulls it together as it is set, the joint will withstand severe vibration loads.

Allowable loads for most rivets have been established by detailed tests. It should be pointed out, however, that the number of applications in which rivet strength is of critical importance are relatively few—at least, in comparison to solid rivets, which are used primarily for highly stressed structures.

Applications of blind rivets in aircraft, electronic gear, transportation equipment, appliances and other consumer and capital goods are for relativley lightly loaded members. Here, the other design and production advantages are foremost. Pilot tests will quickly indicate the size and type of rivet to be employed. Table I lists the hole sizes and lengths recommended for various joint thicknesses.

Selecting the proper rivet . . . Rivets are, of course, available in different types, materials, finishes, and head styles. Frequently, the choice is obvious. In others, only a value analysis will reveal the proper selection. This analysis should go into considerable detail.

Rivet materials . . . Standard rivets are made in three basic materials—aluminum, Monel, and steel; and on special order, heat-resistant stainless steels.

Aluminum is inexpensive, corrosion resistant, and more easily set in large diameters with manual tools than some of the higher strength alloys. It is used in both indoor and outdoor applications, for joining not only aluminum but steel, magnesium, and plastic sections. All-aluminum rivets are more expensive than those with aluminum bodies and steel mandrels. Corrosion resistance, except under the more severe conditions, is of little consequence, because in the break-stem type the mandrel is zinc-

Table I — Application Data for Blind Rivets†

Rivet Dia., In.	Recommended Hole Dia., In.	Drill Number	Grip Length, In.	Ultimate Strength, Psi Aluminum	Monel	Steel
3/32	0.096-0.100	41	0.020-0.070	100	—	—
7/64	0.113-0.117	33	0.020-0.090	—	300	—
			0.091-0.111	—	300	—
1/8	0.128-0.132	30	0.020-0.070	220	420	—
			0.071-0.120	220	420	—
			0.121-0.170	220	420	—
			0.171-0.230	220	420	—
			0.231-0.280	220	420	—
1/8	0.128-0.132	30	0.020-0.125	170, 220	—	325
			0.126-0.187	170	—	—
			0.126-0.250	220	—	325
			0.188-0.250	220	—	—
5/32	0.161-0.165	20	0.020-0.050	310	560	—
			0.051-0.100	310	560	—
			0.101-0.160	310	560	460
			0.161-0.230	310	560	—
			0.231-0.260	—	560	—
			0.231-0.310	310	—	—
			0.261-0.310	—	560	—
			0.311-0.316	310	—	—
3/16	0.191-0.195	11	0.020-0.090	—	940	—
			0.091-0.150	—	940	—
			0.125-0.250	370	—	730
			0.151-0.200	—	940	—
			0.201-0.230	—	940	—
			0.231-0.340	—	940	—
			0.251-0.375	370	—	730
			0.341-0.490	—	940	—
			0.376-0.500	370	—	730
			0.491-0.590	—	940	—
			0.501-0.625	370	—	730
0.200	0.204-0.208	6	0.020-0.100	450	—	—
			0.101-0.140	450	—	—
			0.141-0.200	450	—	—
			0.201-0.230	400	—	—
			0.231-0.320	400	—	—
			0.321-0.400	400	—	—
			0.401-0.480	400	—	—

*Blanks indicate that rivets are not made in the corresponding lengths.
Not all head types (domed and countersunk) or all rivets (break stem or break head types) are available in all sizes.
†The data apply particularly to "PoP" rivets.

plated; and in the break-head type plating is of no consequence.

Aluminum rivets are available with either a bright dip or anodized finish, or with other finishes on special order.

Monel has high shear and tensile strengths, which are further enhanced by cold working when the rivet is set. Being hard, Monel does not seize when used as a pivot or bearing, and being corrosion resistant, it can be used in contact with water, detergents, corrosive liquids, and atmospheres. Disadvantages of Monel rivets are cost in comparison with aluminum or steel, and the fact that larger sizes cannot be set with hand tools.

Steel—usually AISI 1010—has the advantage of high strength and low cost. Because of these features, plus the fact that it can be plated, chemically treated, or enameled, steel has always been a popular material for rivets.

Types of rivets . . . whether a break-head or break-stem rivet is employed depends on preference and application. When the head falls out of a break-head type after the rivet is set, it leaves a through-hole that is undesirable in some products. On the other hand, if the product is likely to be subject to high frequency vibration in service, the mandrel of

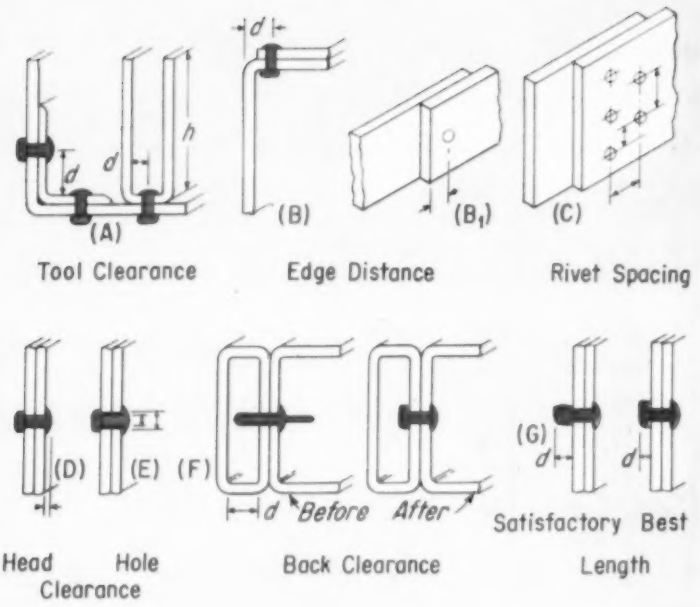
(continued on page 144)

Table II — Analysis of Various Common

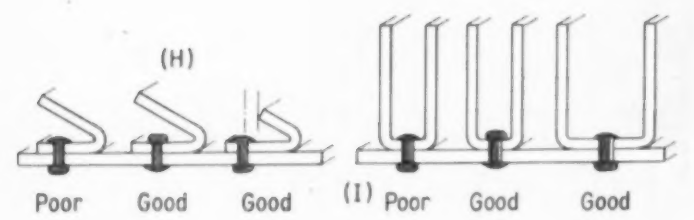
CHECKPOINTS	COMMON FASTENING AND JOINING METHODS — Sheet Metal Screws		Nuts/Bolts/Lockwashers		Solid Rivets		Tubular/Semi-Tubular		Blind		Resistance Welding		Adhesives		Other		SPECIALTY FASTENERS — Stapling/Stitching		Lock bolts		Drive Pin Screws	
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
PLANT AND EQUIPMENT																						
1. Is large capital investment required?		X		X		X		X		X	X		Depends on curing methods and cycle					X		X		X
2. Are locating fixtures necessary?	X			X	X		Depends on Assembly			X	Depends on product		X					X		X		X
3. Must multiple tools or equipment be purchased?		X		X		X	X			X	X			X			X			X		X
4. Is present floorspace adequate?																						
DESIGN																						
5. Is process or fastener adaptable to all metallic materials?		X	X		X		X		X			X		X			X		X		X	
6. Can dissimilar materials be joined?	X		X		X		X		X		Within narrow limits		X				X		X		X	
7. Can nonmetallic materials be joined?		X	Generally not desirable			X	X		X			X	X				X			X		X
8. Can thin sections be joined?		X	Generally not economical		X		X		X		X		X				X			X	X	
9. Can heavy sections be joined?		X	X		X		X		X			X	Generally not recommended					X	X			X
10. Can unequal thicknesses be joined?	X		X		X		X		Within specified limits		Within narrow limits		X				X		X			X
11. Can blind sections be joined?	X			X		X		X	X			X	X					X		X	X	
12. Can method or fastener be used for sections with limited back clearance?	X			X		X		X	X			X	X					X		X	X	
13. Can multiple parts be assembled?	X		X		X		X		X			X	X					X	X			X
14. Are fasteners available in various materials and finishes?		X	Materials only		Materials only		X		X								Materials only			X		X
15. Is a wide range of diameters and lengths available?	X		X		X		X		X									X		X		X
16. Is grip strength high?		X	X		X			X	X		X		X							X		X
17. Is compressive strength high?	X		X		X		X		X		X		X				X		X		X	
18. Is shear strength high?	X		X		X		X		X			X		X				X	X			X
19. Is tensile strength high?		X	X					X		X		X		X				X	X			X
20. Will joint have smooth or flush appearance?		X		X		X	X		X		X		X					X		X		X
21. Will joint withstand vibration?											X											
22. Will projections catch objects or clothing?			X			X		X		X		X		X			X		X			X
23. Will joint be weathertight?											X											
24. Is assembly tamperproof?											X											
25. Is field assembly practical?												X										
26. Can product be dismantled for maintenance or repair?												X										
27. Is fastener cost higher or lower than average?	Lower		Higher than most		About Average		Lower than most		Above Average		No fastener		Depends on resin				Lower than most		High		Above Average	

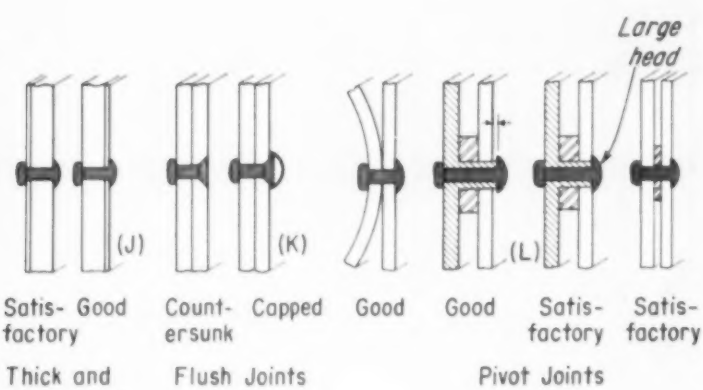
and Specialty Assembly Methods

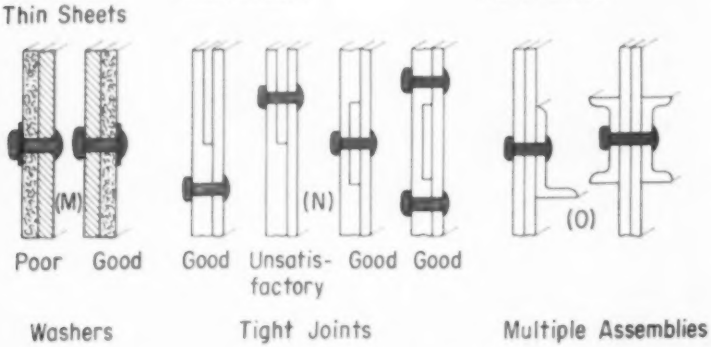
CHECKPOINTS	—COMMON FASTENING AND JOINING METHODS—														SPECIALTY FASTENERS					
	Sheet Metal Screws		Nuts/Bolts/Lock-washers		Solid Rivets		Tubular/Semi-Tubular		Blind		Resistance Welding		Adhesives		Other		Stapling/Stitching		Lock bolts		Drive Pin Screws	
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
PLANT AND EQUIPMENT																						
28. Is in-place or joint cost higher or lower than average?	Lower		Higher		Very high		Lower		Lower		Higher						Lower		Higher		Lower	
PRODUCTION																						
29. Is fastener or process adaptable to high-speed production?	X			X		X	X		X		X		X						X			
30. Is fastener or process adaptable to short or broken run production?	X		X		X	X	X		X		X		X							X		
31. Must materials be cleaned prior to assembly?		X		X		X		X		X	X		X					X		X	X	
32. Are special services (air, water, power) required?		X		X	X			X		X	X			X					X		X	
33. Must product be punched or drilled?	X		X		X		X		X			X		X			X			X		
34. Are secondary machining operations (tapping, countersinking) necessary?		X	Depends on requirements		Depends on requirements			X		X		X		X				X	X		X	
35. Are hole dimensions critical?	X		X		X		X			X		X		X			X			X		
36. Must joining be performed prior to finishing (painting, plating)?		X		X	X			X		X	Depends on process		X				X	X	X		X	
37. Are secondary finishing operations necessary (deburring, grinding)?		X		X		X		X		X	X			X			X		X		X	
38. Can fastening or joining process be performed during assembly?	X		X			X	X		X			X	Usually not. Depends on product					X		X			
39. Will assembly operations damage finish or coating?	X			X	X			X		X	X		X						X		X	
40. Is all-position assembly practical?	X		X		X			X	X			X	X					X		X		
41. Can fastener be fed automatically?	X			X		X	X		X										X		X	
42. Is panel thickness critical?	X		X		X		X			X	X			X				X		X		
43. Will tools reach confined sections?		X		X		X		X	X			X					X		X		X	
44. Can more than one joint be made simultaneously?		X		X		X	X			X	X		X				X		X		X	
45. Must work be transported to tools (i.e. is tool location fixed)?		X		X	Depends on equipment		X			X	X			X					X		X	
46. Can product be damaged during joining or assembly?	X		X			X		X		X	X			X					X		X	
47. Is machine setting difficult?				X		X		X		X	X			X			X		X		X	
48. Must skilled operators be employed?				X	X			X		X	X		X				X		X		X	
49. Will quality of joint be relatively uniform?			X			X		X		X		X		X					X		X	
50. Will visual inspection reveal defects or loose joints?			X		X			X	X			X		X				X		X		



CLEARANCES AND ALLOWANCES







GENERAL DESIGN PRACTICE

Design Details of

Clearances and Allowances

(A)—Tool Clearance . . . Minimum allowable distance from a wall or projection to the rivet-hole centerline is critical, should be checked against tool specifications. Depth of a channel or cylindrical section likewise limits the application if the rivet is inserted as shown. However, tool extensions can often be employed, and the nosepiece of the tool can be extended by as much as an inch.

(B)—Edge Distance . . . From the standpoint of joint strength, the recommended distance from the rivet centerline to the edge of a sheet should not be less than twice the rivet diameter. If joint strength is secondary, this dimension can be greatly reduced. Example: the rivet functions only to hold a bracket or component in position.

(C)—Rivet Spacing . . . This also is a function of application and strength requirements.

(D)—Head Clearance . . . Standard head dimensions vary with rivet size. Height and diameter can readily be determined from specification sheets. Frequently, the work can be countersunk, or the joint designed to prevent interference with mating sections.

(E)—Hole Clearance . . . Permissible clearance depends on whether the fastener grips the wall or clinches underneath. In the latter case, oversized holes are less critical, and one does not depend on wall constriction to prevent breakout.

(F)—Back Clearance . . . Distance from flat of the head to end of the unclinched rivet determines the required back clearance—not dimensions after setting. These values should take into account the maximum combined material thicknesses.

(G)—Rivet Length . . . There is a delicate balance between joint thickness, mandrel-head dimensions, the cold-working properties of the rivet material and, of course, the shank diameter of a blind rivet. On the other hand, one length can be used for a wide range of panel thicknesses. For any use beyond the tabulated data, actual limitations should be determined by test.

General Design

(H)—Angles and Formed Sections . . . Avoid obstructions to the tool, which should set flush on the work. Thus, the "poor" joint requires a special offset tool, may still be inaccessible. Reverse the rivet and set from the other side, or reduce the length of the angular section.

(I)—Channel Sections . . . For adequate tool clearance, set from the underside of the channel or widen the section. A tool extension may be used to reach inside the section, but makes the tool somewhat more awkward to handle.

(J)—Thick and Thin Sheets . . . If there's a choice, it's best to set the rivet against the thicker material. Rivets of this type can be set against 0.030 in. and thinner aluminum stock.

(K)—Flush Joints . . . A truly flush surface can be obtained only by countersinking the outer wall or plate. Dimpling generally is not recommended because of the possibility of the rivet not fully "bottoming" and setting against the hole edge. A smooth, watertight, but not completely flush surface is obtained by countersinking and capping the rivet.

Blind-Riveted Joints

(L)—Pivoted Joints . . . Method at left is satisfactory for low-cost consumer products where some binding can be tolerated until the joint works in. The one shown second from left is perhaps best, because there is some small clearance between the rivet head and the wall.

(M)—Washers . . . If a metallic section is to be assembled to a softer material, a washer may be necessary to provide the necessary rigidity for clinching action. The soft material should be outside with the washer under the rivet head. For conventional assemblies either way is practical.

(N)—Tight Joints . . . Since blind rivets exert considerable gripping force when clinched, the joint shown second from left is impractical. Conversely, either of examples in which a single rivet is employed may prove as satisfactory as the one with multiple rivets.

(O)—Multiple assemblies . . . One, two or more components or sections can be riveted to a base or panel with a single rivet, provided they can be mounted from the front, or the base section is accessible from the rear or underneath.

(P)—Straps and Clamps . . . A blind rivet can be used to assemble straps, clamps, and similar members around a component. Allowance must be made for the squeezing action on the clamp.

(Q)—Housings and Panels . . . Of the many ways to construct a housing or panel, the ones shown here are perhaps the most common. Examples: left—a double-channel section forming the joint to which the panels are assembled and riveted; center—a back-up stringer with a finishing strip inserted between mating panels; right—a base angle with riveted panels and a finishing strip between the gap. In selecting the design, consider cost, appearance, strength and thermal expansion.

(R)—Weatherproof Joints . . . It's difficult to produce a pressure-tight riveted joint, but reasonably moisture resistant, weather-tight assemblies have been evolved.

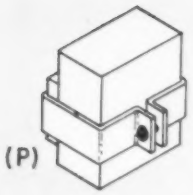
(S)—Extruded Sections . . . Blind riveting is common, because of the limited access and clearances in most extruded sections. Rigidity of the joint at right is far greater than that at left. Setting against unsupported internal projections is seldom recommended.

(T)—Compressible Materials . . . Compressible materials do not provide a firm base for the setting action, and the rivet may tear through. Use of a formed sleeve or bushing, or a washer and back-up plate can solve this problem. If the material is to be riveted to a metal section, the washer is under the plastic.

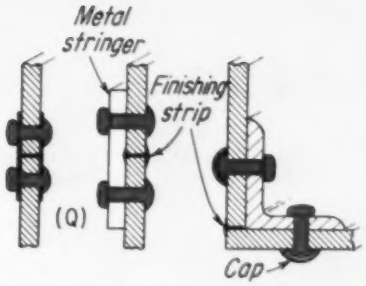
(U)—Tubing . . . For maximum rigidity, the rivet should not extend through both walls of tubular members. The rivet will set blind against the curved inner wall section, or the tubing can be flattened to increase the contact area.

(V)—Plastic Members . . . Preferably, the rivet should be set against a metallic rather than a plastic member. However, the rivets are being set successfully against many molded and extruded plastics, which resist setting pressure without cracking.

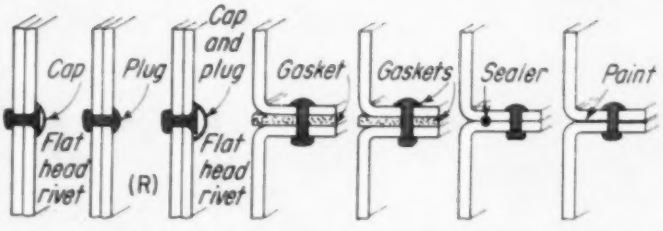
(W)—Blind Holes or Slots . . . Clinching the rivet against the side of a blind hole or into and against a milled slot, intersecting hole, or internal cavity is possible because of the clinching action of the rivet.



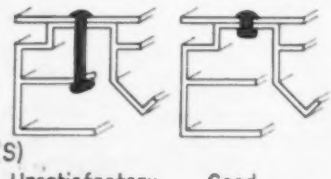
STRAPS AND CLAMPS



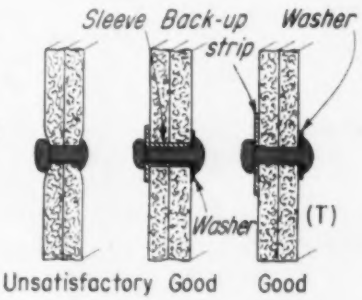
HOUSINGS AND PANELS



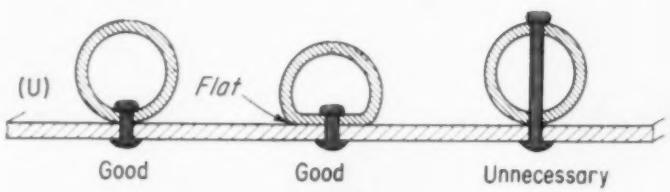
WEATHERPROOF JOINTS



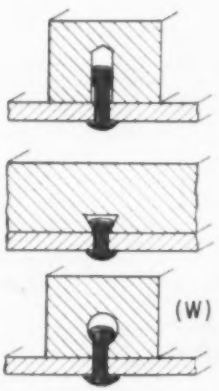
EXTRUSIONS



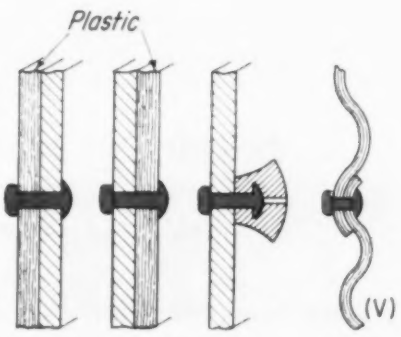
COMPRESSIBLE MATERIALS



TUBING



BLIND HOLES AND SLOTS



PLASTICS

TABLE III—Principal Advantages of Some Competitive Fastening Methods

Type of Fastening	Principal Advantages
Welding (spot or resistance)	1. No holes required in mating parts 2. No fastener to handle 3. Speed of operation 4. Can be a strength joint
Sheet-metal Screws	1. Low initial fastening cost 2. Standardized tools available 3. Easily removable 4. Can be assembled from one side of work
Tubular or semi-tubular rivets	1. Low rivet cost 2. Fast installation 3. More than one rivet can be set per cycle 4. Good appearance on both sides of work
Nuts, bolts, lockwashers	1. High installed strength 2. Suited for low & high volume production 3. Installed with standard tools 4. Hole size not critical
Adhesives	1. No holes required 2. Back-up space not necessary 3. Sealed joints 4. No electrolytic corrosion problem
Wire stitching	1. Low fastener cost 2. No holes required 3. Fast setting time with automatic machines 4. Holds soft material to metal well
Solid rivets	1. Unit cost not high 2. High-strength joints, good in primary structure 3. Uniform appearance on both sides of work 4. Large variety of styles and sizes of heads
Screws in tapped holes	1. Simple replacement of assembly 2. High grip strength 3. Reusable 4. Assembly can be made from one side of of work
Drive-pin blind rivet	1. Hammer is only assembly tool needed 2. Solid rivet, good in shear 3. Tamperproof 4. No secondary operation required
Blind rivets	1. Tools are portable 2. Easily removed 3. Semi-automatic feed frees operator's hand 4. Covers wide panel range with same rivet size

the break-stem type may resonate at objectional noise levels.

So far as the head type is concerned, this depends entirely on joint requirements. If the work is countersunk, or the rivet is to be capped, a flat head is necessary; if not, the standard domed head is recommended.

Assembly analysis . . . No joining process or fastener is the universal answer to all assembly problems. Intensive study is necessary to evaluate one against another.

Too frequently, some factors are omitted during such an evaluation. The modifications that are necessary in plant and facilities are overlooked. Actual in-place cost is not determined, and selection is based on fastened cost alone. Overlooking these items will give a distorted picture of the anticipated results.

There are three, and possibly four, main areas that should be considered when determining which method is best for you: (1) Effect on plant and facilities; (2) design advantages and requirements; (3) production advantages and requirements; and (4) service requirements, which actually should be considered under design. Some of the most important points in each of these areas are listed under "Assembly Analysis," Table II. This type of study, along with a factual cost analysis, cannot help but reveal the best fastener or method for the application.

If one method or fastener has an overriding advantage for the part in question, then the detailed analysis is unnecessary. Table III lists the advantage of some fasteners and processes that are sometimes competitive. Obviously, it would be unfair for an individual such as the author, who is closely associated with one particular type, to list the disadvantages of these as well; his outlook would be prejudiced. But whatever limitations are characteristic of each can readily be determined and examined by the reader. When he has done so, and when he has made his assembly and cost analysis, he has the facts at his disposal for the proper selection.

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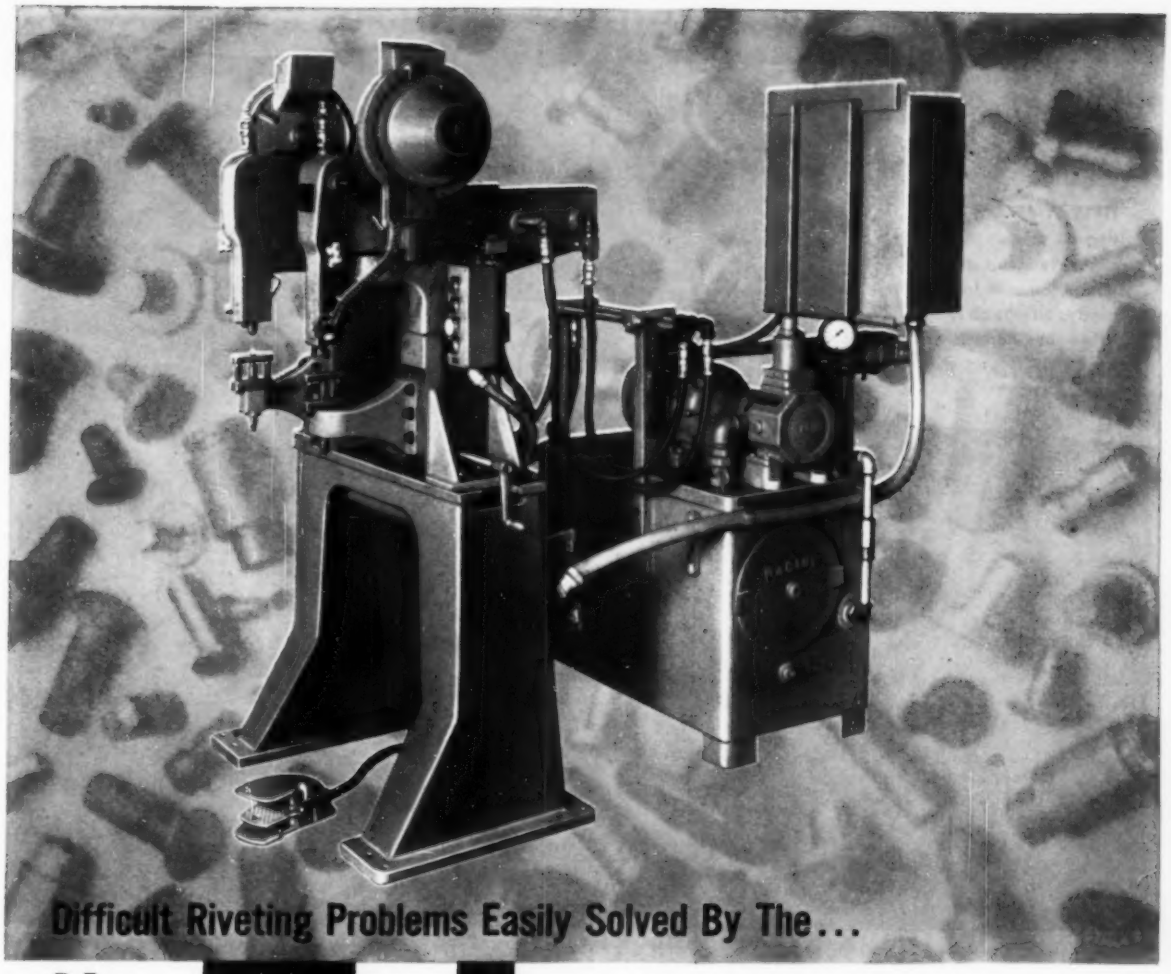

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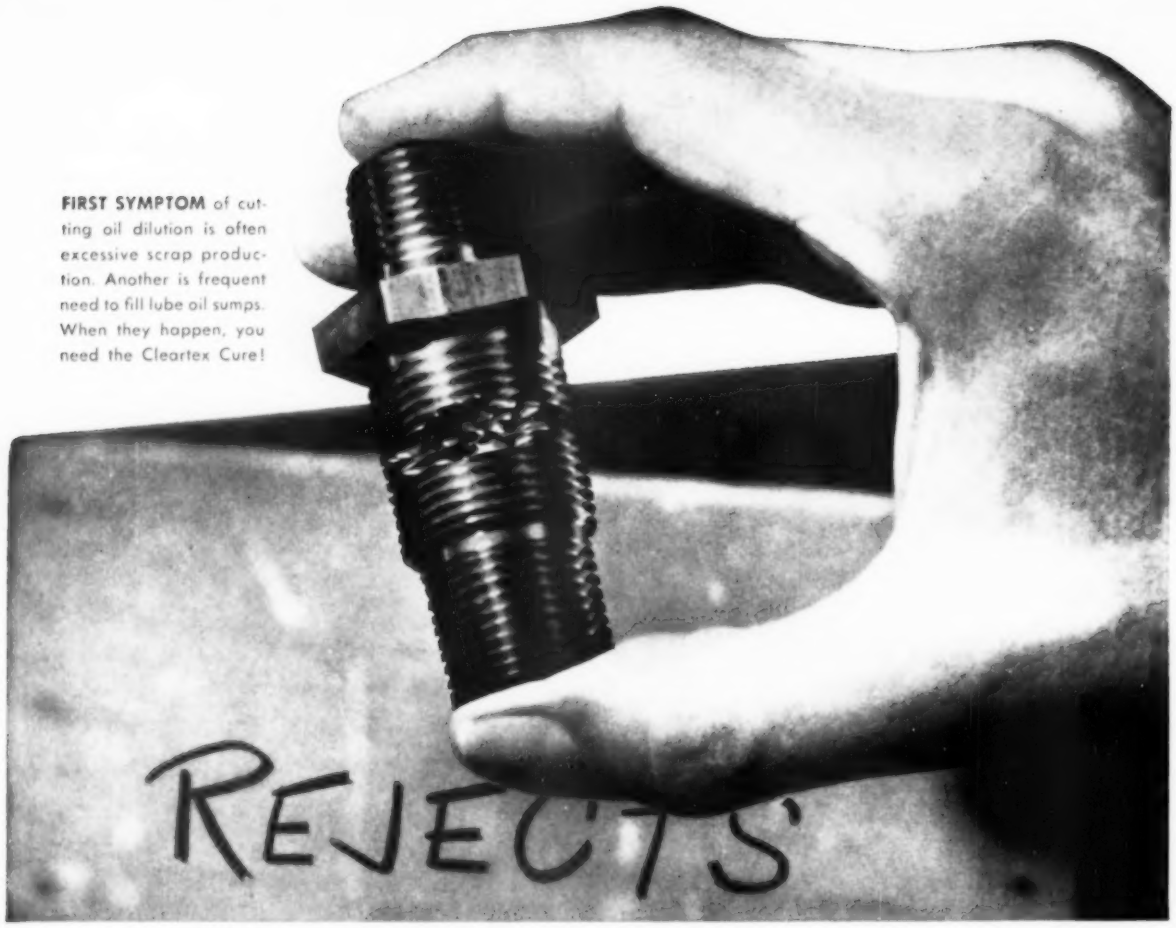

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Limits for Miniature Threads

Source: American Standard ASA B1.10—1958, "Unified Miniature Screw Threads," published by the American Society of Mechanical Engineers

Size Designation[a]	Pitch	External Threads								Internal Threads							
		Major Diameter			Pitch Diameter			Minor Diameter		Minor Diameter			Pitch Diameter			Major Diameter	
		Max	Min	Tol	Max	Min	Tol	Max[b]	Min[c]	Min	Max	Tol	Min	Max	Tol	Min[d]	Max[e]
	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm
0.30 UNM	**0.080**	**0.300**	**0.284**	**0.016**	**0.248**	**0.234**	**0.014**	**0.204**	**0.183**	**0.217**	**0.254**	**0.037**	**0.248**	**0.262**	**0.014**	**0.306**	**0.327**
0.35 UNM	0.090	0.350	0.333	0.017	0.292	0.277	0.015	0.242	0.220	0.256	0.297	0.041	0.292	0.307	0.015	0.356	0.380
0.40 UNM	**0.100**	**0.400**	**0.382**	**0.018**	**0.335**	**0.319**	**0.016**	**0.280**	**0.256**	**0.296**	**0.340**	**0.044**	**0.335**	**0.351**	**0.016**	**0.407**	**0.432**
0.45 UNM	0.100	0.450	0.432	0.018	0.385	0.369	0.016	0.330	0.306	0.346	0.390	0.044	0.385	0.401	0.016	0.457	0.482
0.50 UNM	**0.125**	**0.500**	**0.479**	**0.021**	**0.419**	**0.401**	**0.018**	**0.350**	**0.322**	**0.370**	**0.422**	**0.052**	**0.419**	**0.437**	**0.018**	**0.509**	**0.538**
0.55 UNM	0.125	0.550	0.529	0.021	0.469	0.451	0.018	0.400	0.372	0.420	0.472	0.052	0.469	0.487	0.018	0.559	0.588
0.60 UNM	**0.150**	**0.600**	**0.576**	**0.024**	**0.503**	**0.483**	**0.020**	**0.420**	**0.388**	**0.444**	**0.504**	**0.060**	**0.503**	**0.523**	**0.020**	**0.611**	**0.644**
0.70 UNM	0.175	0.700	0.671	0.027	0.586	0.564	0.022	0.490	0.454	0.518	0.586	0.068	0.586	0.608	0.022	0.713	0.750
0.80 UNM	**0.200**	**0.800**	**0.770**	**0.030**	**0.670**	**0.646**	**0.024**	**0.560**	**0.520**	**0.592**	**0.668**	**0.076**	**0.670**	**0.694**	**0.024**	**0.814**	**0.856**
0.90 UNM	0.225	0.900	0.867	0.033	0.754	0.728	0.026	0.630	0.586	0.666	0.750	0.084	0.754	0.780	0.026	0.916	0.962
1.00 UNM	**0.250**	**1.000**	**0.964**	**0.036**	**0.838**	**0.810**	**0.028**	**0.700**	**0.652**	**0.740**	**0.832**	**0.092**	**0.838**	**0.866**	**0.028**	**1.018**	**1.068**
1.10 UNM	0.250	1.100	1.064	0.036	0.938	0.910	0.028	0.800	0.752	0.840	0.932	0.092	0.938	0.966	0.028	1.118	1.168
1.20 UNM	**0.250**	**1.200**	**1.164**	**0.036**	**1.038**	**1.010**	**0.028**	**0.900**	**0.852**	**0.940**	**1.032**	**0.092**	**1.038**	**1.066**	**0.028**	**1.218**	**1.268**
1.40 UNM	0.300	1.400	1.358	0.042	1.205	1.174	0.032	1.040	0.984	1.088	1.196	0.108	1.205	1.237	0.032	1.422	1.480
	Thds. per inch	inch	inch	inch	inch	inch	inch	inch	inch	inch	inch	inch	inch	inch	inch	inch	inch
0.30 UNM	**318**	**0.0118**	**0.0112**	**0.0006**	**0.0098**	**0.0092**	**0.0006**	**0.0080**	**0.0072**	**0.0085**	**0.0100**	**0.0015**	**0.0098**	**0.0104**	**0.0006**	**0.0120**	**0.0129**
0.35 UNM	282	0.0138	0.0131	0.0007	0.0115	0.0109	0.0006	0.0095	0.0086	0.0101	0.0117	0.0016	0.0115	0.0121	0.0006	0.0140	0.0149
0.40 UNM	**254**	**0.0157**	**0.0150**	**0.0007**	**0.0132**	**0.0126**	**0.0006**	**0.0110**	**0.0101**	**0.0117**	**0.0134**	**0.0017**	**0.0132**	**0.0138**	**0.0006**	**0.0160**	**0.0170**
0.45 UNM	254	0.0177	0.0170	0.0007	0.0152	0.0145	0.0007	0.0130	0.0120	0.0136	0.0154	0.0018	0.0152	0.0158	0.0006	0.0180	0.0190
0.50 UNM	**203**	**0.0197**	**0.0189**	**0.0008**	**0.0165**	**0.0158**	**0.0007**	**0.0138**	**0.0127**	**0.0146**	**0.0166**	**0.0020**	**0.0165**	**0.0172**	**0.0007**	**0.0200**	**0.0212**
0.55 UNM	203	0.0217	0.0208	0.0009	0.0185	0.0177	0.0008	0.0157	0.0146	0.0165	0.0186	0.0021	0.0185	0.0192	0.0007	0.0220	0.0231
0.60 UNM	**169**	**0.0236**	**0.0227**	**0.0009**	**0.0198**	**0.0190**	**0.0008**	**0.0165**	**0.0153**	**0.0175**	**0.0198**	**0.0023**	**0.0198**	**0.0206**	**0.0008**	**0.0240**	**0.0254**
0.70 UNM	145	0.0276	0.0265	0.0011	0.0231	0.0222	0.0009	0.0193	0.0179	0.0204	0.0231	0.0027	0.0231	0.0240	0.0009	0.0281	0.0295
0.80 UNM	**127**	**0.0315**	**0.0303**	**0.0012**	**0.0264**	**0.0254**	**0.0010**	**0.0220**	**0.0205**	**0.0233**	**0.0263**	**0.0030**	**0.0264**	**0.0273**	**0.0009**	**0.0321**	**0.0337**
0.90 UNM	113	0.0354	0.0341	0.0013	0.0297	0.0287	0.0010	0.0248	0.0231	0.0262	0.0295	0.0033	0.0297	0.0307	0.0010	0.0361	0.0379
1.00 UNM	**102**	**0.0394**	**0.0380**	**0.0014**	**0.0330**	**0.0319**	**0.0011**	**0.0276**	**0.0257**	**0.0291**	**0.0327**	**0.0036**	**0.0330**	**0.0341**	**0.0011**	**0.0401**	**0.0420**
1.10 UNM	102	0.0433	0.0419	0.0014	0.0369	0.0358	0.0011	0.0315	0.0296	0.0331	0.0367	0.0036	0.0369	0.0380	0.0011	0.0440	0.0460
1.20 UNM	**102**	**0.0472**	**0.0458**	**0.0014**	**0.0409**	**0.0397**	**0.0012**	**0.0354**	**0.0335**	**0.0370**	**0.0406**	**0.0036**	**0.0409**	**0.0420**	**0.0011**	**0.0480**	**0.0499**
1.40 UNM	85	0.0551	0.0535	0.0016	0.0474	0.0462	0.0012	0.0409	0.0387	0.0428	0.0471	0.0043	0.0474	0.0487	0.0013	0.0560	0.0583

[a]Sizes shown in bold type are preferred. It is recommended that selections be confined to these sizes insofar as possible.

[b]This limit, in conjunction with root form is advocated for use when optical projection methods of gaging are employed. For mechanical gaging the minimum minor diameter of the internal thread is applied.

[c]This limit is provided for reference only. In practice, the form of the threading tool is relied upon for this limit. Control by gaging is not imposed.

[d]This limit is provided for reference only, and is not gaged. For gaging, the maximum major diameter of the external thread is applied.

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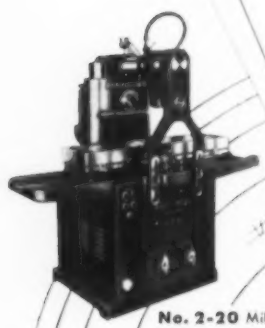
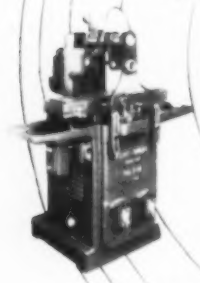
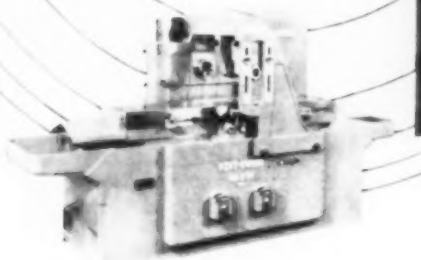


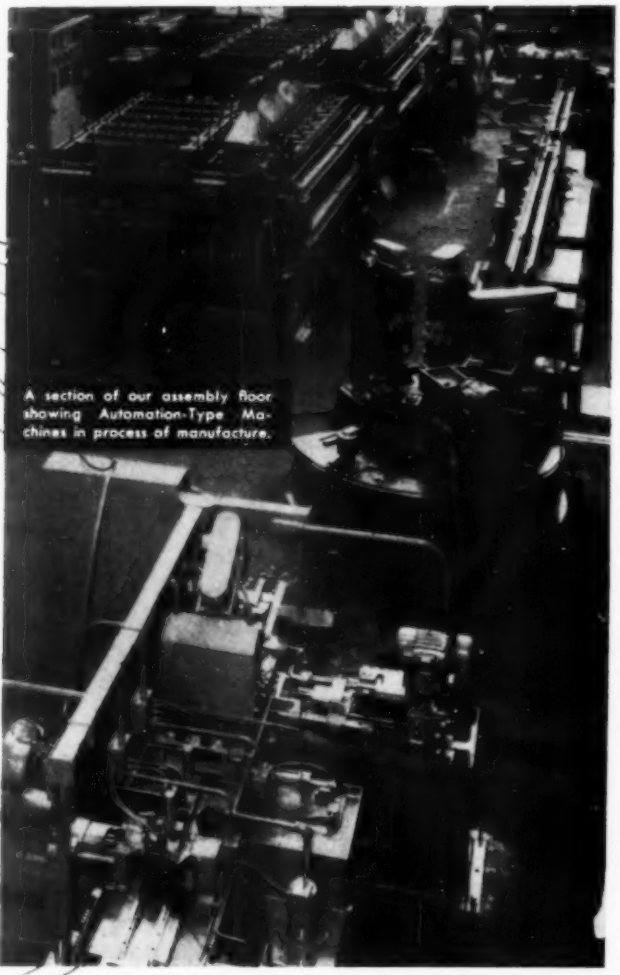
No. 2-20 Miller . . 20" table travel . . 42" x 12" table . . full automatic hydraulic feed.



No. 1-14 Miller . . 14" table travel . . 32" x 9" table . . hydraulic table feed . . full automatic cycle.



No. 3-36 Miller . . 36" table travel . . 64" x 16" table . . full automatic hydraulic feed.



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American Machinist
REFERENCE BOOK SHEET

Machining Titanium—IV

By Bennet V. Whiteson, metallurgical engineer, Titanium Metals Corp of America, New York

SCALE OR FORGING SKIN REMOVAL

Tool Materials

Type of Cut	1st Choice	2nd Choice	3rd Choice
Continuous	C-1 or C-2 carbide	Cast alloys	T-5 H. S. S.
Interrupted	T-5 H. S. S.	Cast alloys	C-1 or C-5 carbide

Tool Geometry

	Tool Material		
Angle	Carbide	Cast alloy	H. S. S.
Back rake,	+ 5 to −5	0 to + 5	0 to + 5
Side rake,	0 to −6(c)	0 to + 5	0 to + 5
SCEA (a),	+ 5 to + 25	+ 5 to + 6	+ 5 to + 6
ECEA (b),	+ 6 to + 10	+ 5 to + 6	+ 5 to + 6
End relief,	+ 5 to + 10	+ 5 to + 7	+ 5 to + 7
Side relief,	+ 5 to + 10	+ 5 to + 7	+ 5 to + 7
Nose radius, in.	0.050-0.125(d)	0.02 to 0.03	0.02 to 0.03

Machine Setting	Titanium Grades		
	Commercially Annealed	Annealed Alloys	Heat-Treated Alloys
Carbide Tools			
Speed, Sfpm	80-100	50-70	25-45
Feed, Ipr	0.005-0.008	0.005-0.008	0.0025-0.004
Depth of cut, in.	Get under scale (e)		
Cast-Alloy Tools			
Speed, Sfpm	40-50	25-35	15-25
Feed, Ipr	0.003-0.006	0.003-0.006	0.003-0.006
Depth of cut, in.	Get under scale(e)		
High-Speed-Steel Tools			
Speed, Sfpm	20-35	15-25	5-15
Feed, Ipr	0.002-0.003	0.002-0.003	0.002-0.003
Depth of cut, in.	Get under scale(e)		

Classification of High-Speed Steels

AISI CODE	Nominal % of Alloying Elements				
	Tungsten	Chromium	Vanadium	Cobalt	Molybdenum
T-1	18	4	1	—	—
T-2	18.5	4	2	—	—
T-4	18	4	1	5	—
T-5	18.5	4	1.75	8	—
T-15	14	4	5	5	—
M-10	—	4	2	—	8

ROUGH TURNING & INTERRUPTED CUTTING

Tool Materials

Type of Cut	1st Choice	2nd Choice	3rd Choice
Interrupted	T-5 H. S. S.	Cast Alloy	C-1 or C-5 carbide
Form	T-5 H. S. S.	Cast Alloy	C-1 or C-5 carbide
Plunge	T-5 H. S. S.	Cast Alloy	C-1 or C-5 carbide
Severe plunge	Cast Alloy	T-5 H. S. S.	C-1 or C-5 carbide
Dead center	Cast Alloy	T-5 H. S. S.	C-1 or C-5 carbide
Grooving	Cast Alloy	T-5 H. S. S.	
Continuous rough turning	C-1 or C-2 carbide	Cast alloy	T-5 H. S. S.

Tool Geometry

	Tool Material		
Angle	Carbide	Cast Alloy	H. S. S.
Back rake,	+ 5 to −5	0 to + 5	0 to + 5
Side rake,	0 to −6	0 to + 5	0 to + 15
SCEA (a),	+ 5 to + 25	+ 6 to + 15	+ 6 to + 15
ECEA (b)	+ 6 to + 10	+ 5 to + 6	+ 5 to + 6
End relief,	+ 5 to + 10	+ 5 to + 7	+ 5 to + 7
Side Relief,	+ 5 to + 10	+ 5 to + 7	+ 5 to + 7
Nose radius, in.	0.03 to 0.045	0.02 to 0.03	0.02 to 0.03

Machine Setting	Titanium Grades		
	Commercially Pure	Annealed Alloys	Heat-Theated Alloys
Carbide Tools			
Speed, Sfpm	100-240	75-120	50-95
Feed, Ipr	0.008-0.015	0.008-0.015	0.008-0.015
Depth of cut, in.	◂ Greater than 0.100 ▸		
Cast-Alloy Tools			
Speed, Sfpm	80-90	40-50	25-40
Feed, Ipr	0.005-0.010	0.005-0.010	0.005-0.010
Depth of cut, in.	◂ Greater than 0.100 ▸		
High-Speed-Steel Tools			
Speed, Sfpm	25-124(f)	25-60	10-50
Feed, Ipr	0.004-0.050	0.004-0.015	0.004-0.015
Depth of cut, in.	◂ Greater than 0.100 ▸		

(a) Side cutting edge angle
(b) End cutting edge angle
(c) Negative rake angles best, but require rigid equipment
(d) Reduce nose radius if excessive chatter occurs
(e) Tool should cut at least 0.020 in. deeper than tool radius
(f) As fed rates increase, speed should decrease to maintain reasonable tool life

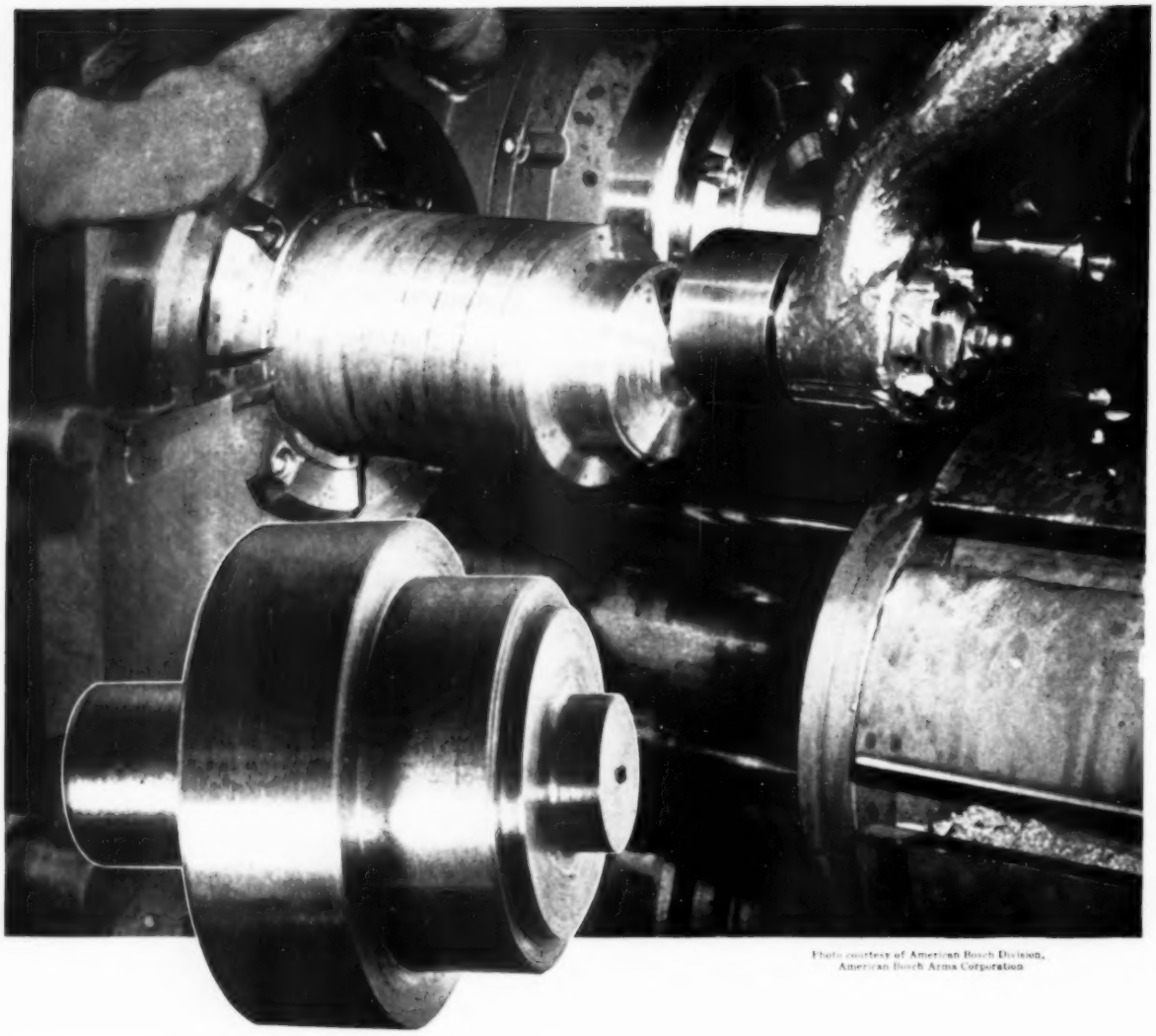

Photo courtesy of American Bosch Division, American Bosch Arma Corporation

Leaded Nitralloy Takes a Big Bite Out of Machining Time!

By switching to Nitralloy Leaded for this hydraulic head, secondary lathe operations and expensive heat treatment were completely eliminated. Produced in a single machining operation, the part is now sent directly to the grinding department. Spindle speeds and feeds were also increased.

For complete information about other fast-machining Aristoloy leaded steels or standard carbon, alloy and stainless grades, call the Copperweld representative in your nearest large city. Or write for booklet entitled, "A Complete Line of Leaded Steels," and NEW PRODUCTS & FACILITIES CATALOG.

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Machining Titanium—V

SEMI-FINISH TURNING

Tool Materials

Type of Cut	1st Choice	2nd Choice	3rd Choice
Continuous	C-2 carbide	T-5 H. S. S.	Cast alloy
Plunge cuts, grooving,	T-5 H. S. S.	Cast alloy	C-2 carbide

Tool Geometry

	Tool Material		
Angle	Carbide	Cast Alloy	H. S. S.
Back rake,	−5 to −5	0 to +5	0 to +5
Side rake,	−6 to −6	0 to +5	0 to +15
SCEA (a),	−5 to −20	+6 to +15	+6 to +15
ECEA (b),	−6 to −10	+5 to +6	+5 to +6
End relief,	−5 to +10	+5 to +7	+5 to +7
Side Relief,	−5 to +10	+5 to +7	+5 to +7
Nose radius, in.	0.03 to 0.45	0.02 to 0.03	0.02 to 0.03

(a) Side cutting edge angle
(b) End cutting edge angle

Machine Setting	Titanium Grades		
	Commercially Pure	Annealed Alloys	Heat-Treated Alloys
Carbide Tools			
Speed, sfpm	220-320	100-160	75-155
Feed, ipr	0.006-0.15	0.006-0.015	0.006-0.015
Depth of cut, in.	0.030-0.100	0.030-0.100	0.030-0.100
Cast-Aloy Tools			
Speed, sfpm	100-200	50-80	35-70
Feed, ipr	0.004-0.010	0.004-0.010	0.004-0.010
Depth of cut, in	0.030-0.100	0.030-0.100	0.030-0.100
High-Speed-Steel Tools			
Speed, sfpm	60-160	30-60	15-50
Feed, ipr	0.003-0.008	0.003-0.008	0.003-0.008
Depth of cut, in.	0.030-0.100	0.030-0.100	0.030-0.100

FINISH TURNING

Tool Materials

Type of Cut	1st Cchoice	2nd Choice	3rd Choice
Continuous turning	C-3 or C-4 carbide	T-5 H. S. S.	Cast alloy
Grooving	T-5 H. S. S.	Cast alloy	C-1 or C-2 carbide

Tool Geometry

	Tool Material		
Angle	Carbide	Cast Alloy	H. S. S.
Back rake,	0 to +5	0 to +5	0 to +5
Side rake,	0 to +15	0 to +5	0 to +5
SCEA (a),	0 to +20	+5 to +6	+5 to +6
ECEA (b),	+6 to +10	+5 to +6	+5 to +6
End relief,	+5 to +10	+5 to +7	+5 to +7
Side Relief,	+5 to +10	+5 to +7	+5 to +7
Nose radius, in.	0.030 to 0.045	0.020 to 0.030	0.020 to 0.030

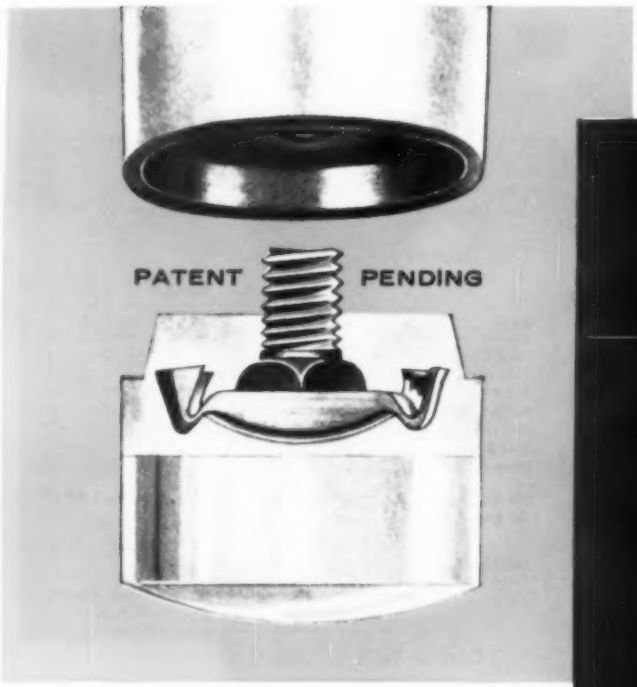
(a) Side cutting edge angle
(b) End cutting edge angle

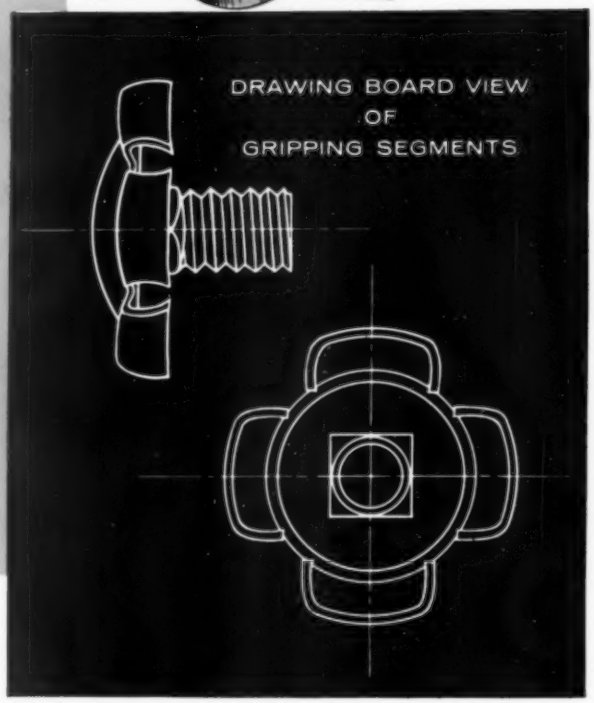
Machine Setting	Titanium Grades		
	Commercially Pure	Annealed Alloys	Heat-Treated Alloys
Carbide Tools			
Speed, sfpm	200-350	100-300	75-275
Feed, ipr	0.003-0.012	0.003-0.012	0.003-0.012
Depth of cut, in.	0.003-0.030	0.003-0.030	0.003-0.030
Cast-Aloy Tools			
Speed, sfpm	100-200	65-80	50-70
Feed, ipr	0.002-0.005	0.002-0.005	0.002-0.005
Depth of cut, in.	0.003-0.030	0.003-0.030	0.003-0.030
High-Speed-Steel Tools			
Speed, sfpm	76-160	45-60	30-50
Feed, ipr	0.002-0.005	0.002-0.005	0.002-0.005
Depth of cut, in.	0.003-0.030	0.003-0.030	0.003-0.030

CARBIDE DESIGNATIONS

Manufacturer	Straight Carbides				Compounded Grades			
AISI	C-1	C-2	C-3	C-4	C-5	C-6	C-7	C-8
Adamas	B	A	AA	AAA	DD	D	C	CC
Carboloy	44A	883	905	999	78C	78B	78	330
Carmet	CA3	CA4	CA7	CA8	CA-610	CA-610	CA-606	CA-605
Firthite	H	HA	HE	HF	T-04	TXH	TXL	T-31
Kennametal	K-1	K6	K8	K-11	Km	K25	K-54	K7H
Talide	C89	C91	C93	C-95	S-88	S-90	S-92	S-94
Vascaloy-Ramet	JR-54	JR-54	2A7	2A7	VR77	VR-75	VR-73	EH
Wesson	GS	GI	GA	GF	WS	WM	WH	WH
Wiley	E8	E6	E5	E3	945	710	606	509

It won't budge...





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ARMATURE SHAFTS MACHINED ON AIR-FEED AUTOMATIC

The Harley-Davidson Motor Co., is well known throughout the world for its complete line of motorcycles and motor-scooters. The latest addition to their line is the new Topper motor-scooter. Advanced design and quality craftsmanship, plus wise application of modern production machines and tooling techniques, have won this company wide recognition for their products.

Many of the precision parts for these motorcycles and motor-scooters are made on the nineteen Greenlee Automatic Bar Machines shown in the photograph. An excellent example of this is the 8-15 16 inch long generator armature shaft shown in the tooling layout.

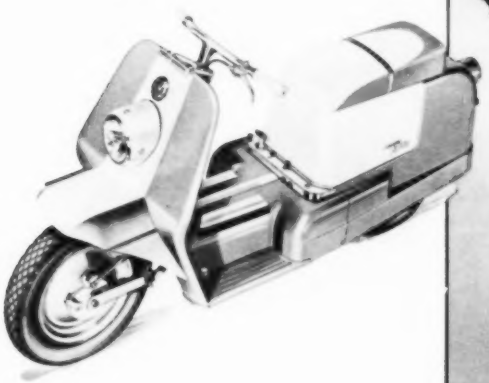
This part is machined on a standard 2″-6 Air-Feed Bar Automatic at a gross production rate of 53 pieces per hour with High Speed Steel tools. It is machined from 13 16 inch round stress-proof steel at a spindle speed of 517 rpm, producing 112 sfm on the outside diameter of the stock. A 2-7 8 inch tool slide is used with a .0051 inch feed on the endworking tools.

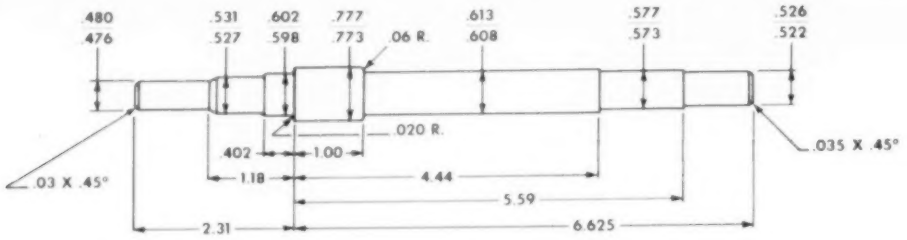
The part is fed out 9-1 8 inches in the first position against a live-center receding stock-stop. When the stock contacts the stock-stop the collet closes and the stock-stop moves away from the end of the bar, permitting the stock to rotate freely and index to the next position. The movement of the stock-stop is controlled by a small air cylinder mounted on the gear box. After the stock is fed out the .773-.777 inch diameter and a small section of the .608 inch diameter is formed.

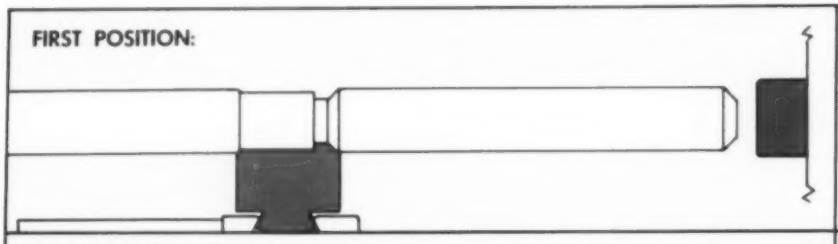
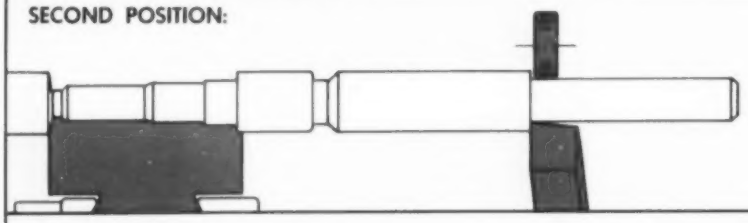
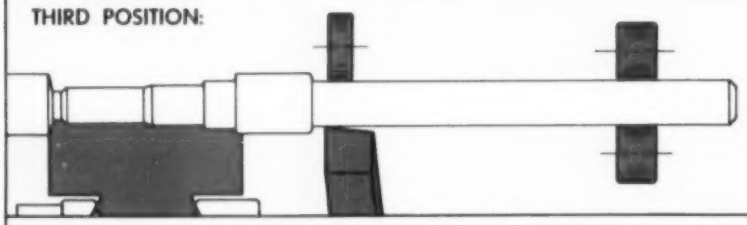
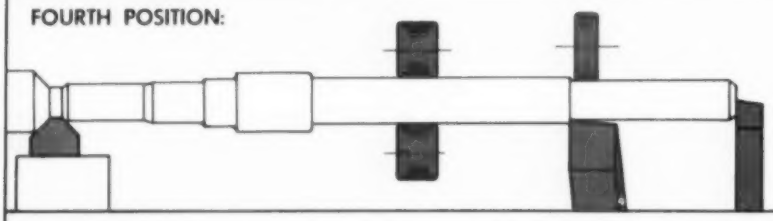
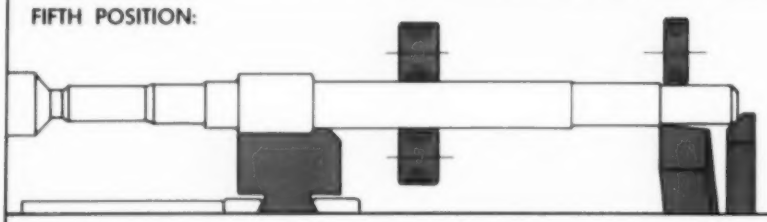
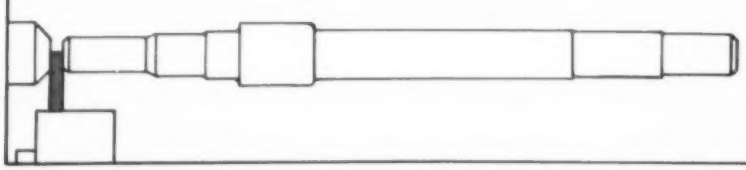
The .608 inch diameter is roller turned halfway and the backend of the part is rough formed in the second position. A three roll roller rest mounted on the tool slide in the third position supports the work piece while the remainder of the .608 inch diameter is roller turned and the backend is finish formed by a standard dovetail form tool.

In the fourth position the .573 inch diameter is roller turned and the end faced with an auxiliary turner. A flat form tool breaks down for cut-off and forms a 45° bevel on the front end of the next piece. The purpose of this bevel is to provide a better starting condition for the roller turner in the second position. The .522 inch diameter is turned with a standard roller turner and chamfered by an auxiliary turner and the .773-.777 inch diameter is finish formed in the fifth position. The machining operations in the fourth and fifth positions are supported by standard three roll roller rests. The part is cut off in the sixth position.

The Topper has a one-cylinder two-cycle engine with a fully automatic transmission. Gets up to 100 miles per gallon.





		FEED	SFM
FIRST POSITION: 	1. Feed out to 9⅛" 2. Rough form .775"-.777" and .608" diameters Cam ratio: 6:1	— .0051	— 112
SECOND POSITION: 	1. Roller turn .608" diameter half way 2. Rough form backend and breakdown for cutoff Cam ratio: 6:1	.0051 .0008	112 112
THIRD POSITION: 	1. Roller support on .608" diameter (3-roll) 2. Roller turn .608" diameter to required length 3. Finish form backend Cam ratio: 6:1	— .0051 .0008	— 112 105
FOURTH POSITION: 	1. Roller support on .608" diameter (3-roll) 2. Roller turn .575" diameter 3. Face end 4. Breakdown for cutoff and form 45° bevel on the front end of the next piece Cam ratio: 5:1	— .0051 .0051 .001	— 83 78 64
FIFTH POSITION: 	1. Roller support on .608" diameter 2. Roller turn .522" diameter 3. Turn .035" x 45° chamfer 4. Finish form .775"-.777" diameter Cam ratio: 6:1	— .0051 .0051 .0008	— 78 71 105
SIXTH POSITION: 	1. Cut off Cam ratio: 2:51	.002	56

If you wish to receive AUTOMATIC NEWS regularly, write Greenlee Bros. & Co., Rockford, Ill.

Talking Shop...

Gold Is Where You Find It

BUT SOMETIMES the finding can be a cause for despair, rather than rejoicing. For instance, metallurgists at a steel company found traces of the "precious" metal in a batch of high-alloy steel scrap that was scheduled for remelting in the manufacture of an alloy steel with very exacting requirements as to chemical composition, and they weren't a bit happy about it. It turned out that the gold came from the plated tips of scrapped stainless steel fountain pen points.

If there is a moral in this, it is: It pays to segregate your scrap.

Slow Take

A FRIEND of ours was crossing the street recently at Columbus Circle in front of the Soviet Exhibition with one of the key engineers who are manning the exhibits. As they waited for the light to change, our friend called attention to a passing Plymouth station wagon and said "There goes a car just like mine." The Soviet engineer turned in amazement and asked, "You own a car?"

"Yes," said our friend, "don't you?" The Russian, a devoted adherent of the Soviet regime and a highly successful man with a rank corresponding to chief engineer, said no—he could afford a wife or a car but not both—so he had chosen a wife.

What bothers us about this true story is that the Rusisan could have spent several weeks in the middle of our traffic jams without realizing that practically *everybody* owns a car.

Optimum Point

NEW EFFORT is going, these days, into finding the optimum point for machining—not the longest tool wear. (See AM—April 6 '59, p 117). Kennametal is pushing this hard in an effort to persuade their customers to save "dollars by spending pennies" for more cutting tools. Horace Frommelt is responsible for calling our attention to some wise words on this subject uttered by Frederick Taylor in 1906:

"For many years it has been usual for salesmen of tool steels to give detailed accounts of the number of hours which tools, made from their steels, would cut metals without the necessity of regrinding. In fact, tool steel literature abounds in statements of the long life of tools with one grinding, implying that this is the proper standard for measuring their value. By referring, however, to paragraphs 693 and 710 it will be seen that for ninety-nine one-hundredths of the work of a shop, this criterion is of no value whatever, and that the man who boasts of having run a tool without regrinding, say, for a longer period than one and one-half hours on ordinary shop work, is merely boasting of how little he knows about the art of cutting metals cheaply."

That makes just as good sense now as it did a half century ago if we broaden it to include carbides and ceramics, then unknown.

More Loose Terms

ANOTHER term that takes a beating is "precision." One shop may consider a couple of thousandths as real close; another may not consider it precision till they reach 50 millionths. And in both shops, our readers are likely to put up a shelf at home and consider it real precision if the board is square within 1/32 in. We all use these loose terms, more or less out of necessity, but it helps if we define just how much precision we mean.

It also helps if we use the terms only if we can really measure accurately the dimensions to which we are working. Thermal expansion being what it is, you may be kidding yourself if you think you're doing precision machining on a hot day with no temperature control.

Small Lot

WHAT IS a small lot? What is a large lot? We asked that question of a large number of metalworking plants some time ago and got answers about as varied as you might expect. Small lots varied (literally) from 1 to 1 million, and large lots from 10 to 10 million. This makes it a little difficult to talk with assurance about small-lot manufacturing. But that is where most of the problems and most of the economies are likely to be found. The plant that considers 10 million a large lot probably doesn't worry nearly as much about the efficiency with which those little 1 million lots are turned out.

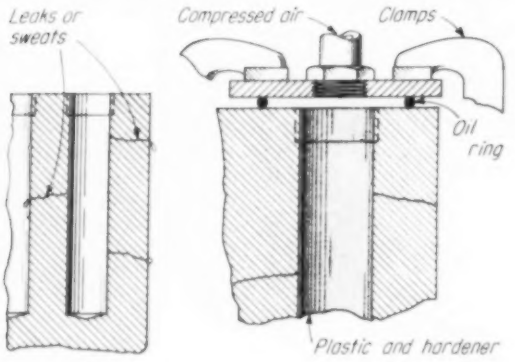
Nibble, Nibble

WE'VE DEVOTED a lot of space to ingeneous and original work being done in the Soviet Union. In finding it, we also turn up some that is not so new. A recent dispatch from our Vienna man tells us that the Soviets claim to have developed a new vibration cutting machine and proceeds to describe a nibbler.

And then there is that well-known Soviet inventor, Mr. Reguspatoff (Reg. U. S. Pat. off.).

Practical Ideas...

Detecting and Curing Porous Aluminum Castings



When machining of your rough aluminum castings bogs down because of a high rate of rejection due to porosity, the first thing to do is to determine the nature and location of the affected area. A hydrostatic test may reveal sweating, but this is no indication that the casting is merely minutely spongy; it may have hidden internal flaws.

The way to make sure is to select 2 or 3 castings at random and saw them into pieces, especially through heavy sections and where thick and thin sections meet. The pieces are then degreased in a caustic-soda solution (10-15% concentration) for 15-20 minutes at 120°-140° F.

A thorough cold-water rinse follows, after which the parts are given a brightening bath at room temperature of 50% nitric acid, 2% hydrofluoric acid and the balance water. This treatment is followed by another cold-water rinse and the parts are then brushed to remove all gray deposits. Hot water is used to heat the parts for drying with compressed air. Porosity, sponginess, and other internal flows will be clearly visible.

Assertions that such an etching, called "deep etching," produces porosity can quickly be disclaimed by giving pieces of rolled, extruded, or forged aluminum the same treatment. The comparison will be convincing. Deep etching of cast iron and bronze castings require different baths.

• Now for the cure of porous castings in either aluminum, bronze, or iron. Here's a simple shop procedure that employs the same basic ingredients as commercial impregnation setups requiring costly equipment.

When testing a part for porosity, do not check it with pressurized oil. Submerge it in water and use compressed air from within. Sketch illustrates an assumed example where leakage has been detected from a cavity to the outside of the casting, and also through the wall separating adjoining cavities.

A commercial product called Cycleweld cement is used to seal the pores. This cement is a compound of 90% plastic and 10% hardener which is the sealing element used in commercial impregnating systems. When cured, this compound will chemically resist all liquids.

The plastic and hardener are thoroughly mixed and poured into the leaking cavity. Next, a steel plate, fitted to a compressed-air line, is sealed with an oil ring and clamped over the cavity. When air pressure is applied the pores are filled; and with continued pressure sweating will appear on the outside surfaces and inside the adjoining cavities.

The clamps are then removed and the plastic poured out. In cases of intricate cavities or channels, any remaining plastic should be blown out with compressed air. Normally, 24 hours are required for the plastic to set, but an accelerated cure can be achieved by placing the part in a 160-170° F oven for about 3 hours.

John Obrebski, metallurgist, Monarch Machine Tool Co, Sydney, Ohio

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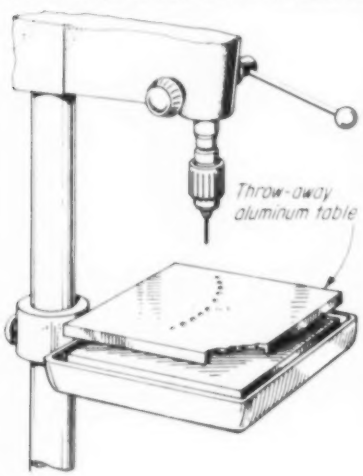
Now You Can Have a "Throw-Away" Drillpress Table



Drillpresses of both standard bench models and small precision type jobs are in constant use in our shop. And then, too, much of our work is on small parts and some in sheet metal. Hole dimensions vary from large sheet-metal drills to No. 80, and sometimes smaller, twist drills.

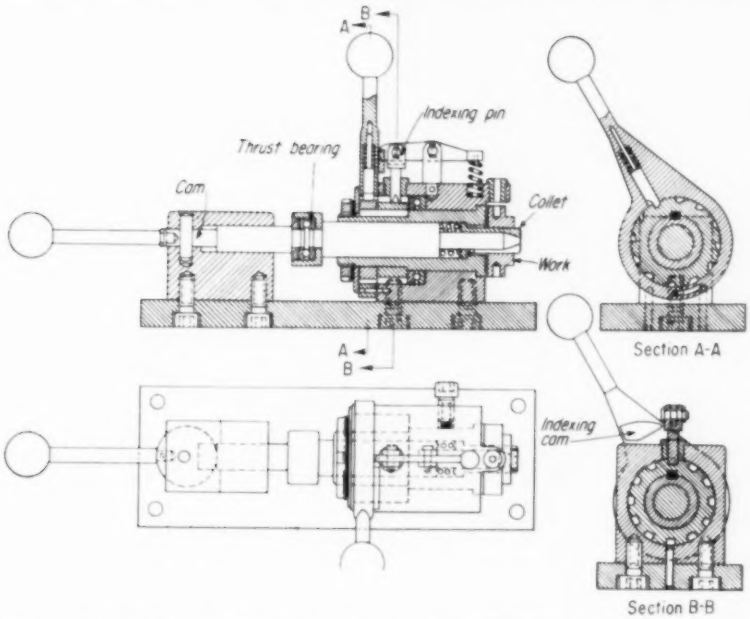
All of this work requires that an underlay of some kind be used on the table. The reasons are that the table must be protected and the clearance hole in the table is too large for the table to afford any support for small work. Wood as an underlay is usually not accurate enough, and metal plates have a tendency to shift with the added annoyance of having chips getting in under them.

I therefore designed and made what I call a "throw-away" drillpress table. As shown in the sketch, it's a piece of aluminum milled out to fit over the inside edges of the smaller type table. When a table is too large to expend the milling work upon, I simply drill and tap a few holes through a ½-in. aluminum plate and bolt it to the table from the underside.

With a "throw-away" table in place, drilling can proceed as if you were working directly on a solid table. When too many and too large holes have been drilled into the protective cover, and after its usefulness has been stretched by several shiftings, it can be thrown away and economically replaced with another one.

Glen Price, Coney, Kansas

Semi-Automatic Indexing Drill Fixture is Fast Loading



When you're tooling up for a second operation you have generally two alternatives to keep production cost down. The first is, make the tooling simple, and if this isn't possible, your second choice is to make it fast operating.

Though the part for which the illustrated fixture was constructed is not complex, the fact that 12 holes has to be accurately spaced and drilled on its periphery makes the second operation more critical than the preceding ones. The choice is therefore obvious since precision indexing has to be incorporated.

Section A-A and B-B shows how positive indexing is achieved with the simple push and pull of a lever. Each such motion rotates a collet adapter and presents the next location to be drilled. Several things happen during this cycle. As the pawl in the lever skips from one ratchet notch to the next on the push stroke, a cam lifts the spring-loaded index pin out of the index-wheel slot. The pin is thus held while the pawl engages the next ratchet notch and is only released at the end of the pull stroke when it drops off the cam. Motion of the ratchet lever is limited by a pin working in a radial slot through the ratchet frame. Both index and ratchet wheels are keyed to the collet adapter with a common key.

The collet adapter is housed in a block mounted on a base plate. At the front end of the block a counterbore accepts the shoulder of the adapter while the back end is bored up to receive a thrust bearing and the index wheel. Mounted on the adapter's extended end are the ratchet wheel and a large-gage washer followed by a lock washer and adapter-adjusting nut. Once nut adjustments have been made to allow adapter and ratchet wheel free motion without backlash, the lockwasher lugs are bent over into the slots on the OD of the nut to secure it. On top of the block are mounted the drillbushing, index-pin guide bushing, and the rocker-arm assembly to which the indexing pin is attached.

An expanding-type collet is used. It is machined to fit the bore of the work, and is activated by a spring-returned pushrod which is tapered to match the collet bore. The back end of the rod is fitted with a bell housing including a thrust bearing to provide rotating pressure point between the rod and the locking device.

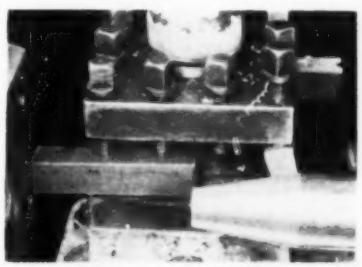
The locking device is contained in a block mounted at the other end of the base plate. It consists of a cam which, when rotated by the attached lever, acts upon a plunger to apply pressure on the thrust bearing. This arrangement permits rotation of the collet while it is under continuous pressure to grip the work.

Hjalmar Dahl, Upplands Vasby, Sweden

Combined Feeds Produce Taper

Here is a frequently overlooked method of taper turning on a turret lathe. It is a convenient alternate if your turret lathe is not equipped with a taper attachment. This arrangement makes it possible to generate smoothly finished tapers through a combination of power feeds.

The job illustrated is being run by simultaneous cutward feed of the cross slide and forward feed of the ram. A piece of square stock, clamped in one of the toolpost stations, acts as a bumper against which the turret face bears to push the carriage forward. During this operation, the carriage feed is disengaged so the carriage may slide freely on the bed.



Range of taper per foot is naturally limited to the resultants of combinations of the two mentioned feed movements. But sometimes it is only necessary to have an approximate tpf, and one of the available combinations will come close to the optimum. When this is the case, we modify the taper thus produced by the use of a skiving type of form tool which makes a light finish cut. Some turret lathe manufacturers will provide you with a tabulation of combinations possible, but combination can also be worked out mathematically.

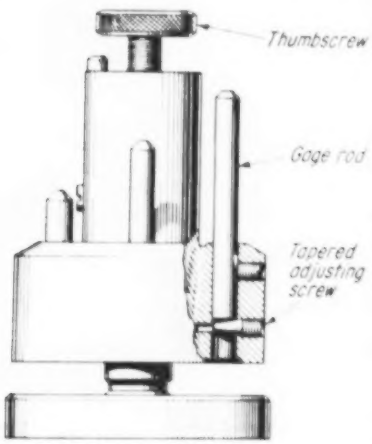
H J Gerber, Stillwater, Okla

Practical Ideas...

Reference Gages Speed Inspection

Multi-dimensional turret gages at AC Spark Plug make it possible to check 4 to 5 times as many machined castings as before. These inspection gages are made up and preset, one unit for each part to be checked, so all reference dimensions are readily available for a part under inspection. The tool-inspection crib has the responsibility of presetting all gage assemblies before they can be used by the inspectors.

A turret has a set of hardened and lapped rods (as many as 12 can be used) which are individually adjustable to dimensions required. A large thumbscrew on top adjusts the height of the unit, bringing up all gage rod tips in unison to allow for the height the workpiece is raised on the fixture.



Gage construction is solid and accurate. The rods are HSS hardened to 63 R_c and lapped on the ends. All lower ends are chamfered to match tapered adjusting screws that set rod heights. Top ends are truncated 90° points which present small landings, reducing chances of erroneous readings. The base and rod holder are made of SAE 1020 steel, carburized, hardened and ground all over.

In use, the gage is zeroed to a setting block on the fixture by adjusting the thumbscrew. Next, the height-gage indicator is zeroed against rod 1 and then touched to the bottom edge of hole 1. If readings correspond, all's fine; if not, differential is noted. This procedure is repeated for each succeeding hole.

To check hole positions on the other coordinate, the inspection fixture is turned on its side—and again, with appropriate rods—the gage unit is zeroed out and inspection carried out as in the first setup. Rod numbers on the gage are color coded to indicate which rods are used with what position of the fixture. Should engineering changes require new inspection standards, the rods can be exchanged for others of different lengths.

Frank A Cuthbertson, master mechanic, A C Spark Plug Div, General Motors Corp, Milwaukee

J M Askins
Lufkin, Texas

WON

$25 **In addition to regular payment for his idea:**

END MILLS FROM DISCARDED TAPS

in the June 29, 1959 issue

An extra $25 will be paid for the best Practical Idea in each issue of *American Machinist*. Selection of the winner is made by a group of our readers.

PAYMENT—$25 in addition to regular rates for the items published to be paid as soon as reader votes are received—usually three to four weeks after the date of issue. The winner will also be announced in these pages as soon thereafter as practicable.

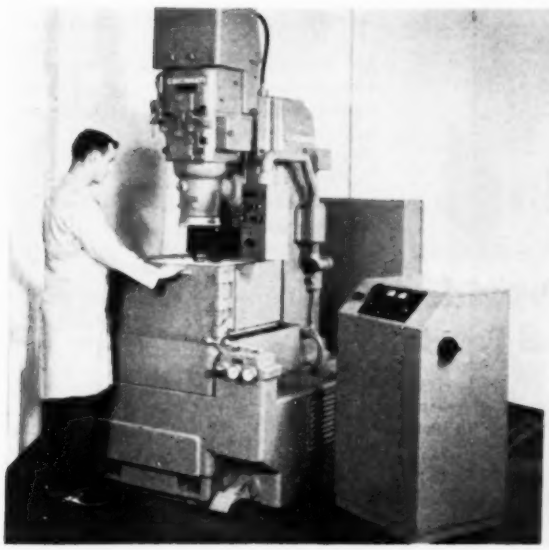
JUDGES—A group of 200 *American Machinist* readers is asked to select preferred articles in each issue. The group is a true cross-section of all readers, and changes entirely each time. Their votes, in addition to guiding the editors, select the best Practical Idea. If at any time their votes result in a tie, $25 will be paid to each co-winner. Decision of the readers will be final in each case.

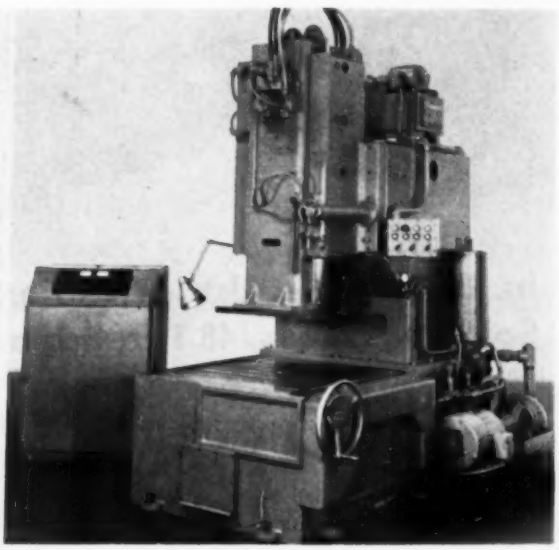
REQUIREMENTS—Only items in the Practical Ideas pages are eligible, and they must be submitted directly by the originator. Do not worry about your shortcomings as a draftsman, photographer, or author—every item will be edited in accordance with *American Machinist* standards and suitable illustrative or explanatory material added where needed. Readers will judge only the finished product—in terms of its usefulness to them.

WHO MAY ENTER — Anyone may enter except employees of the McGraw-Hill Publishing Co, Inc, and those of advertising agencies or departments. Suggest to your employees that they submit ideas.

HOW TO ENTER — Send all entries to "Practical Ideas Editor," American Machinist, 330 West 42nd St, New York 36, N.Y.

New Shop Equipment
Materials and Parts





Cincinnati Introduces 33 Electrical Discharge Machines

A complete line of 33 Elektrojet electrical discharge machines, made up mostly from 16 basic building block units, has been introduced by Cincinnati Milling Machine Co. Building blocks include 2 bases, 2 slides, 4 workheads, 4 base-tank units, and 4 power supplies. The entire line is said to be designed new from the ground up, with no components taken from other machine tool lines.

In electrical discharge machining (AM—Aug 24 '59, p90), sparks are propagated between an electrode and the workpiece. The sparks erode the workpiece and duplicate the shape of the electrode. At the same time the surface of the electrode is also eroded, but at a much slower rate. From 10,000 to 250,000 times a second, sparks flash across a gap of about 0.001 in. digging craters of 0.001 in. dia by vaporizing the metal or ejecting it in tiny molten globs. Workpiece and electrode are bathed in a dielectric fluid to quench the sparks and wash away the debris.

Cincinnati claims that Elektrojet machines, using a pulse-type circuit, can produce bottom corner radiuses as small as 0.002 in. Large die cavities can be sunk to ±0.005 in. and smaller cavities to ±0.001 in. Cavities of 50 cu in. can be machined at metal removal rates of as much as 0.016 to 0.018 cu in. per min. Die blocks up to 18 in. thick can be handled by the large diesinking machine.

Building Blocks

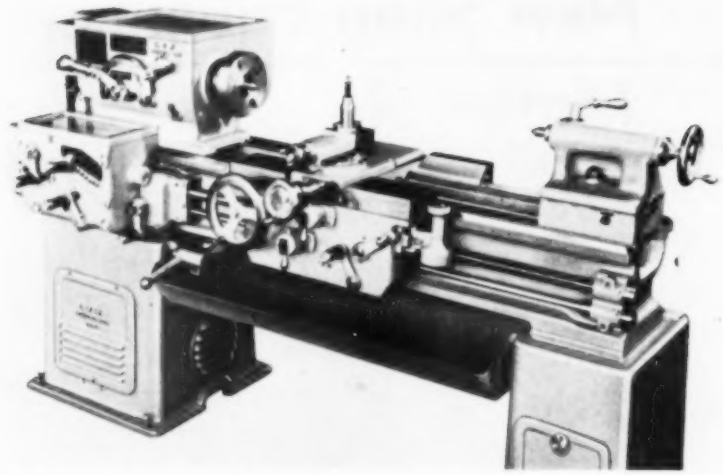
The basic line consists of a single base and column on which can be mounted any one of four workheads and four base-tank units: **Non-rotating head** is for operations such as die sinking where the desired shape is produced by the vertical feed of a formed electrode. **Rotating head** rotates the electrode as it feeds into the workpiece, providing better machining conditions which result in increased stock removal rates. On this workhead, the quill feed can be used alone for plunge type cuts. **Universal head** (on machine at left) provides planetary motion similar to a jig grinder in addition to quill feed and electrode rotation. **Ram-type head** is for extra large plunging cuts like those required when manufacturing forging and drawing dies. **Solid tank** can be used for small easily clamped workpieces machined in production quantities. **Open-front tank** (on machine at left) has a front panel that can be lowered to make it easier to load and position parts. **Disappearing tank** can be lowered into the bed of a machine, making the workpiece accessible from all sides. **Moving table tank** is mounted on transverse and longitudinal slides, making it easy to position the workpiece under the electrode. This tank can be equipped with servo drives to move it under the electrode at a controlled rate.

Machines can be equipped with fixed or adjustable workhead slides and 20, 40, 60, or 100 amp power supplies.

Also included in the Elektrojet line are two grinding machines and a heavy duty diesinking machine (illustrated at right). The die sinker is built with a larger base and column size than the basic line and has a ram-type workhead and disappearing tank.

Milling Machine Div, Cincinnati Milling Machine Co, Cincinnati 9, Ohio

MORE DATA? Circle 51, inside back cover



16-in. Geared Headstock Lathe Provides 12 Spindle Speeds, 48 Threads and Feeds

A 16-in. geared headstock lathe, made by Carroll-Jamieson, provides 12 spindle speeds from 20 to 900 rpm and 48 threads and feeds. The 5-hp motor is mounted in the cabinet leg with multiple vee belt drive to headstock vee pulley.

A standard LO type taper nose spindle or an optional threaded nose spindle is mounted in tapered roller bearings. An improved friction type clutch and brake provide instantaneous spindle control and allows the motor to run continuously. A clutch lever controls lead screw and feed rod, with an interlocking device to prevent engaging the units simultaneously.

The standard bed casting is ribbed gray iron which can be equipped with optional inserted, ground and hardened ways which have a 64-66 Rockwell hardness. Beds can be supplied in short, medium, or long sizes.

Carroll-Jamieson Machine Tool Co, Batavia, Ohio

MORE DATA? Circle 54, inside back cover

TAPE-CONTROLLED CAM MILLING MACHINE mills three-dimensional contours complete from the solid on fuel metering drum cams and can be used to machine other complex cam configurations. Work spindle and longitudinal traverse are geared together and driven by a hydraulic servo motor. The cross slide, mounted on the traverse table, is driven independently by a second servo motor—*Ex-Cell-O Corp, 1200 Oakman Blvd, Detroit 32, Mich*

MORE DATA? Circle 55, inside back cover

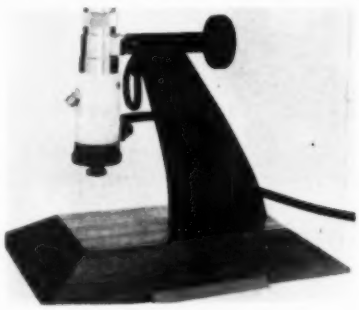
Forgeable Sintered Tungsten Available From Firth Sterling

Pure tungsten and tungsten alloy such as tungsten-molybdenum and tungsten-tantalum are available in hollow conical and cylindrical shapes up to 8 in. dia and 4 in. long, as well as in billets $4\frac{1}{2}$ in. dia. and 12 in. long, which can be forged into finished pieces.

Company is currently producing, by vacuum sintering techniques, tungsten metal of 99.9% purity with densities exceeding 90% of theoretical, which makes this material suitable for forging at 3400-3500 F. Preliminary tests indicate that tungsten produced by these techniques has shown outstanding machinability characteristics at room temperature, after forging.

Firth Sterling Inc. 3113 Forbes St, Pittsburgh 30, Penna

MORE DATA? Circle 56, inside back cover



New High Temperature Source Ranges From 2500 to 12,000 F

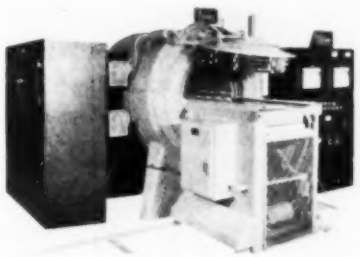
Small plasma generator designed for general lab and production use is especially suited to lowcost operation. It operates from a standard welding generator, using a commercial bottled gas such as argon, nitrogen, or helium, and tap water for cooling. Basically it is a high intensity electric arc consisting of a water cooled tungsten cathode and a copper anode. It is $2\frac{1}{4}$ x 9 in. long, weighs $3\frac{1}{2}$ lbs.

By using the plasma generator, techniques may be developed to flame-spray refractory oxides and ceramics onto other materials to greatly increase their refractory properties. Unit can be fired into a vacuum or pressure chamber without major modification. In flame spraying, the material is fed as a powder into the flame, becomes liquid, and is hurtled in fine, spherical droplets against the surface to be plated. Initial ceramic spraying experiments have shown that a slightly porous coating is deposited

which improves the specimen's surface thermal insulating properties and resistance to shock. Avco has also used the plasma jet for materials testing and spectroscopic studies. Unit can be equipped with a pistol grip handle to develop techniques for arc plasma flame cutting and other applications.

Avco Research and Advanced Development Div, 201 Lowell St, Wilmington, Mass

MORE DATA? Circle 57, inside back cover



Automatic Heat Treating Furnace Is High Vacuum, Cold Wall Type

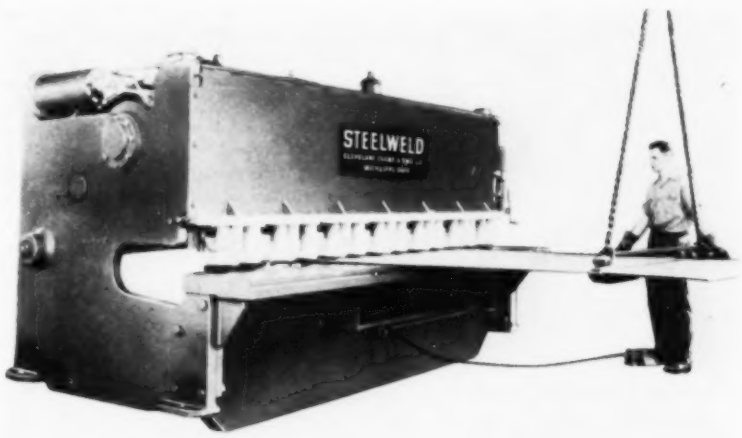
Series V-300 has work space 24 in. wide, 36 in. deep, 12 in. high; operating pressure of 1 micron Hg; input of 75 kw; operating temperature of 2275 F.

Unit is especially adaptable for copper and for nickel brazing of flat stainless assemblies. High vacuum greatly reduces surface tension of the brazing alloy which eliminates crevice formation and corrosion normally associated with atmosphere or hydrogen brazing. Flat assemblies are heated sandwich style from above and below for extremely uniform heating. Other uses of the furnace include hardening, tempering, drawing and annealing refractory metals, reactive metals, stainless and special alloy steels.

Total floor space required is approximately 12 x 12 ft which includes 50 x 57 in. for the furnace, 32 x 72 in. for the vacuum system, 46 x 15 in. for control panel, 24 x 69 in. for power panel, and 30 x 41 in. for the loader platform. Unit is charged horizontally and has a roller hearth. Vacuum system consists of a 100-cfm mechanical pump and a 10-in.-dia. vapor diffusion pump. Graphite heating elements are used. Furnace can be set for manual or automatic operation. All operations or any single operation can be changed from automatic to manual at any time during the sequence.

Ipsen Industries, Inc, 715 S Main St, Rockford, Ill

MORE DATA? Circle 58, inside back cover



Line of Steelweld Hydraulic Shears Uses Pivoted Blade, Single Hydraulic Cylinder

Steelweld line of hydraulic shears is said to differ from other hydraulic shears in two respects: the blade is powered by a single hydraulic cylinder and it is pivoted and turns in a curved path.

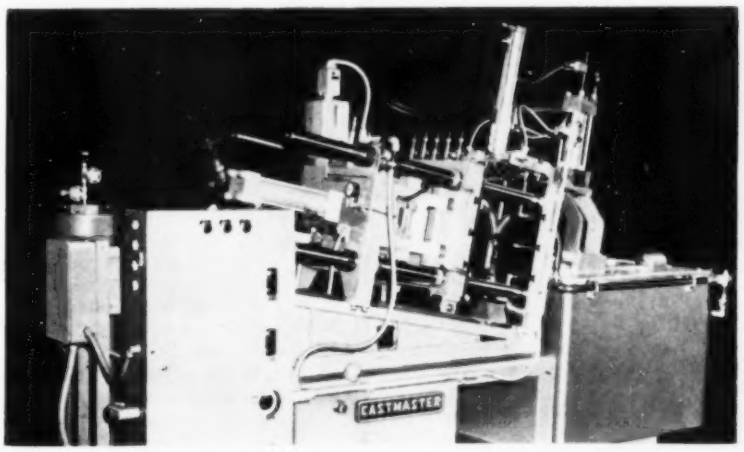
The single cylinder applies constant force throughout the cutting action by means of a cross-shaft that links the piston rod to the two ends of the blade. Using one cylinder greatly simplifies the hydraulic circuit and provides a second, higher speed for lighter thicknesses so that material up to 65% of the rated thickness is cut at double the downstroke, full-load speed.

According to the manufacturer, the pivoted-blade shearing principle overcomes disadvantages of guillotine-type shears. There are no slides and guides to wear out of true because the upper blade operates on two heavy pivot pins on the end housings and travels in a circular path.

The shears have a 24 in. throat and are available in sizes for cutting plate lengths to 30 ft in thickness up to 2 in. Both knife clearance and cutting stroke are easily adjustable.

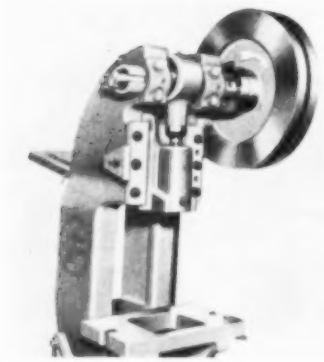
Cleveland Crane and Engineering Co, Wickliffe, Ohio

MORE DATA? Circle 59, inside back cover



AUTOMATIC 100-TON HOT CHAMBER ZINC DIE CASTING MACHINE is designed to produce up to 1000 shots per hour. It has inclined platens and injection cylinder to cut nozzle drippings and permit castings to fall freely. Die mounting plates are 21½ by 21½ in.; space between tie bars is 13½ by 13½ in.; max die stroke is 8 in.; injector cylinder stroke is 6½ in.—*Castmaster, H-P-M Div, Koehring Co, 23901 Aurora Rd, Bedford, Ohio*

MORE DATA? Circle 60, inside back cover



Improved 5-Ton OBI Press Designed for Economy Use

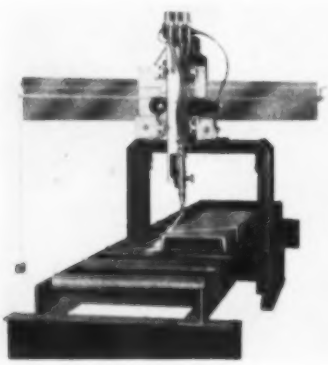
Series 40 Standard OBI press develops 5 tons of force and is designed to meet economy requirements, according to the manufacturer. Standard stroke is 1 in. with a 7½ in. shut height. Strokes of 1¼, 1½, and 2 in. are also available.

Ram has 1 in. adjustment and is equipped with a 1 in. hole for tooling. Center of slide to frame measures 4 in. with a bed area of 6¼ x 10 in. Positive single-trip clutch mechanism and adjustable brake on the crankshaft are included as standard equipment.

Series 40 presses operate at 280 to 290 strokes per minute with a 1725 rpm, 1/3-hp motor, and have all Benchmaster accessories such as automatic friction roll feeds, dial index feeds, barrier guards, and floor legs.

Benchmaster Mfg Co, 1835 W Rosecrans Ave, Gardena, Calif

MORE DATA? Circle 61, inside back cover



Structural Cutter Makes Mitered or Straight Cuts

New unit reduces handling, layout, and cutting time on I beams, H beams, angles, channels, bars, and plates. Two independently operated variable speed motors activate the horizontal and vertical geared tracks, insuring a smooth, steady cut.

Constant heat is achieved by solenoid valves which coordinate the gas and oxygen at the burning tip. Costly removal of burning slag, a problem with conventional burning, is reduced to a minimum by combining uniform speed and heat. Adjustable dial can be set for mitered or straight cuts. Shape is rolled forward on unit's roller conveyor to prescribed cutting position and locked in place by magnets. Model is available in stock-cutting sizes of 24, 36, and 48 in.

Steffan Mfg Corp, 1585 S Lincoln Ave, Salem, Ohio

MORE DATA? Circle 62, inside back cover

Air Gage Checks Thickness, Draws Profile of Sheet Stock

Pneumatic Gage Recorder, for laboratory and production inspection, checks the thickness and simultaneously charts the thickness deviation. The operator moves the size-sensing element along the sheet, or the sheet can be moved through the gage head. Size deviation is automatically recorded on a 4 in. wide strip chart. Chart travel can be made either intermittent or continuous at the flick of a switch. With index drive, approximately ⅛ in. length of chart is used for each gage reading. Standard chart speeds are 1, 2, or 6 ipm or 9 in. per hour.

Both contact and non-contact air gage tooling can be used with the gage which offers a full scale tolerance range from ±0.0003 to ±0.040 with proper tooling. The combination air gage recorder can also be used with spindles for checking bores and fixtures for charting various dimensions. A two-dimension unit with two scribing pens is also available.

Sheffield Corp, Dayton 1, Ohio

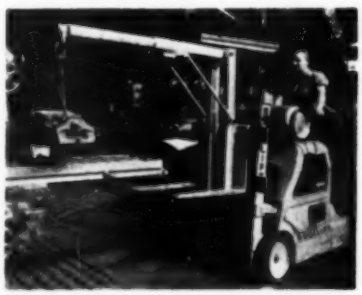
MORE DATA? Circle 63, inside back cover

Lowcost Vertical Mill Does Precision Milling and Boring

Vertical toolroom milling machine, said to have the range and capacity of larger mills, sells for under $1000. Equipped with a swivel head, the ram and turret machine performs angular as well as vertical operations. A quill "feather feed," said to be advantageous in precision boring, employs a smooth leadscrew and nut arrangement. V-belt drive, with belt positions able to be set with one hand, offers a speed range of 250 to 3450 rpm in six spindle speeds. Spindle brake, spindle lock and internal quill lock are standard equipment. Controls are located for maximum operator convenience. Dials are 3½ in., satin finish chrome. Specifications: table 7 x 27 in.; longitudinal feed 16 in.; crossfeed 8 in.; vertical feed 15 in.; quill travel 4 in.; ram movement 12 in.

US Burke Machine Tool Division, Brotherton Rd, at Penna Railroad, Cincinnati 27, Ohio

MORE DATA? Cihcle 64, inside back cover



LIFT TRUCK ATTACHMENT called Porta-Boom (supplied to fit any make or model of truck) is designed for production handling of odd shaped and bulky pieces as well as maintenance jobs. Capacities are 2000 lbs at 60 in., 6000 lbs at 34 in. Price, $195—*Morton Mfg Co, Broadway & Hoyt, Muskegon Heights, Mich*

MORE DATA? Circle 65, inside back cover

56

S&F GEAR TESTERS CAN'T BE WRONG!

AND THEY NEVER ARE— AT ECLIPSE-PIONEER

Division of Bendix Aviation Corp., Teterboro, N. J.

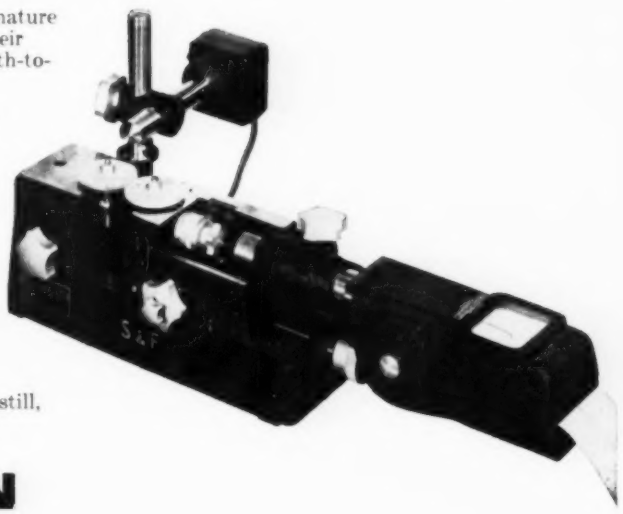
Turning out Precision Class 3 Gears is almost second nature to Eclipse-Pioneer. These are the gears that go into their famous directional gyros for aircraft and missiles. Tooth-to-tooth error, .0002". Total composite error, .0003".

The first S & F Tester bought by Eclipse-Pioneer four years ago told them what they wanted: no other gear checker was so accurate, so easy to use.

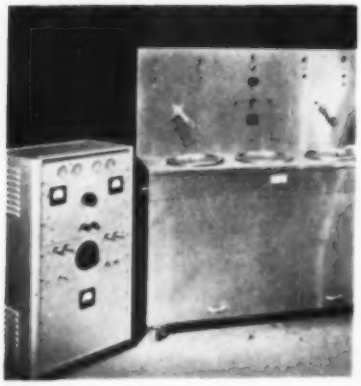
So they kept buying them. For floor after floor. Section after section. Year after year. Now, 56 S & F Testers act as guardians of precision all over the plant—assurance that Eclipse-Pioneer gears really hold to the tolerances called for.

Would *you* like to be assured that the gears you make—or buy—are as accurate as they're supposed to be? Check them on an S & F—guaranteed to repeat within .00001"—as 359 plants now do.

Ask us to send you the name of a nearby user. Better still, may we demonstrate the S & F for you?



KURT ORBAN COMPANY, INC.
36 Exchange Place, Jersey City 2, N. J.



Ultrasonic Cleaner Uses High, Low Frequencies Simultaneously

VT-700 ultrasonic cleaner uses several ultrasonic frequencies simultaneously to produce a degree of cleanliness not previously obtainable, according to the manufacturer.

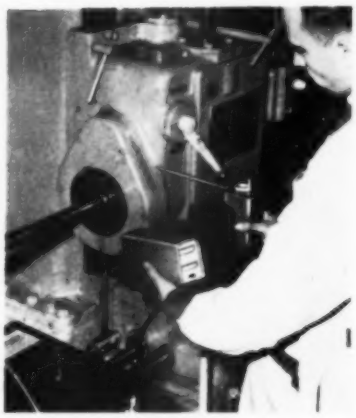
The unit runs at 400 kc with a number of frequencies ranging down to 20 kc. A 400 kc frequency removes dirt particles around 1 micron in size and penetrates into small crevices while the lower frequencies provide cleaning action for larger dirt particles and on areas not accessible to high frequency because of shadowing.

Cleaning containers measure 12 in. dia by 12 in. deep and have a 25 qt capacity. Barium titanate transducers are alternately driven by a 700-w RF generator.

The equipment was designed to clean assembled teletype mechanisms and can also be used on such things as gear trains, valves, porous metal filters, blind holes, complex mechanical assemblies, typewriters, gears, potentiometer parts, and grinding wheels.

McKenna Laboratories, 2503 Main St, Santa Monica, Calif

MORE DATA? Circle 66, inside back cover



Precision Portable Balancer Added to Stewart-Warner Line

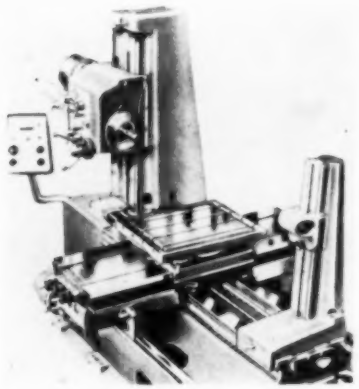
Model 2390, designed for vibration analysis of all types of assembled machinery, is adjustable to any job from below 10 millionths of an inch to over 1/10 to ⅛-in. amplitude of vibration. It consists of strobe and meter head, electronic unit, vibration pickup extension cable, tripod, and spare electronic tubes.

In operation, the amplitude of vibrations of the part under test are electro-magnetically converted into electrical impulses by the vibration pickup unit. These impulses are then amplified in the electronic unit which triggers a strobe light to freeze the image of the rotating part, pin-pointing the trouble source. Angle of unbalance is indicated through the stroboscope and amount of vibration appears on a meter. Utilizing an infinitely turnable flat spring, the resonance pickup automatically filters out extraneous vibrations. The pickup can be placed on the machine part, freeing operator's hands or, for hard-to-reach places, a probe is attached to the pickup unit and held against the part to be balanced.

Unit operates on 115 v 60 c single phase current; price is $1195.

Stewart-Warner Corp, 1826 Diversey Pkwy, Chicago 14, Ill

MORE DATA? Circle 68, inside back cover



Supermill Unit Features Four-Bedway Construction

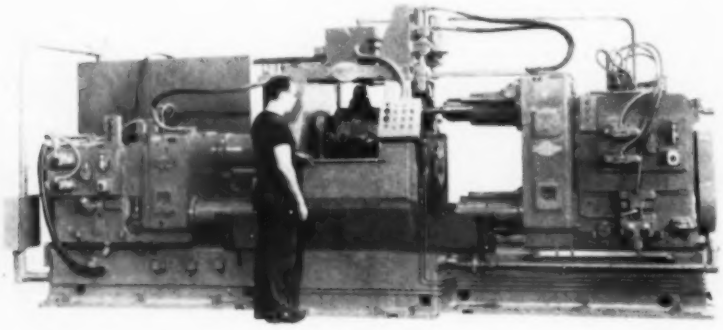
Model AL55D Supermill boring, drilling, milling, and turning machine (Italian) features new four-bedway construction that doubles the maximum cross-travel of the table. Two additional ways, parallel and integral with the regular ways, support the oversize saddle, permitting an unusually extensive working area capacity for a 2 in. bar machine.

The 2 in. dia spindle has a vertical travel of 24 in. and the extended cross travel of the table spreads to 45 in. In addition to doubling the working area capacity, the four-bedway design also provides a stabilizing effect that practically eliminates lateral friction.

The 26 x 24 in. table is motor driven with 6 power feeds and rapid traverse in all directions. Max distance between spindle sleeve and outboard support is 66 in. Rotating on anti-friction bearings, the 12-speed nitrided spindle is provided with instantaneous starting, stopping, and reversing.

Dist by S & S Machinery Co, 140 53rd St, Brooklyn 32, NY

MORE DATA? Circle 69, inside back cover



THREE DIFFERENT REAR AXLE HOUSINGS are machined on this 2-way, 5-station horizontal indexing machine that produces 94 pieces per hr at 100% efficiency. Two clusters of reamers operate at accelerated feed rates. Hardened and ground steel ways are standard—*Grenlee Bros & Co, Rockford, Ill*

MORE DATA? Circle 67, inside back cover

DIES TO WORK MICA AS PRECISELY AS THIS

require the critical inspection that only the Kodak Contour Projector provides.

SPECIAL HIGH-PRECISION DIES are needed to stamp out an intricate mica blank like this, used for positioning electronic tube elements.

Tolerances are on the order of ±0.0002". In making such dies the firm of Schneider and Marquard, Inc. (specialists in punches and dies for precision mica products) was not satisfied with the accuracy limitations of ordinary inspection methods, and turned to *optical* inspection.

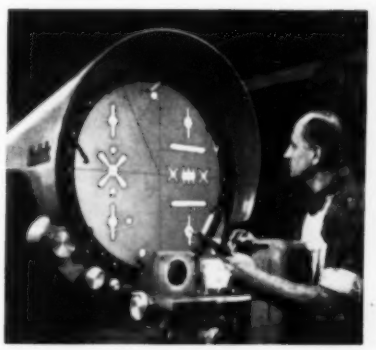
Even then, they found that only one instrument could provide the extremely precise degree of inspection needed, with unparalleled accuracy on all parts of the screen image. That instrument was the Model 30 Kodak Contour Projector.

Accuracy, plus . . . With this large-screen (30-inch) comparator you get a projected image that's as *free* from distortion as the science of optics will permit—accuracy on *every* inch of the viewing screen, including the very edges.

You get a sharp, high-contrast image that's erect and unreversed at all magnifications. Changes in magnification can be made at the flick of a switch.

More refinements . . . You also get efficient head-on surface illumination and a full 16" throat clearance between collimator lens and front mirror. This clearance is constant at *all* magnifications, permits staging of large parts without repositioning. The many other advanced refinements, extreme optical stability, and rugged construction of the Model 30 Kodak Contour Projector make it a leading choice for large-screen precision micrometry or routine gaging.

Cut inspection costs . . . Along with accuracy, optical gaging with Kodak Contour Projectors offers you savings in tool costs, increased inspection rates, and the economies that result from a minimum of operator training.



You can use optical gaging almost anywhere in your plant . . . receiving, assembly, production, inspection, or toolroom. There are 6 Kodak Contour Projectors to choose from, one matched to your inspection needs.

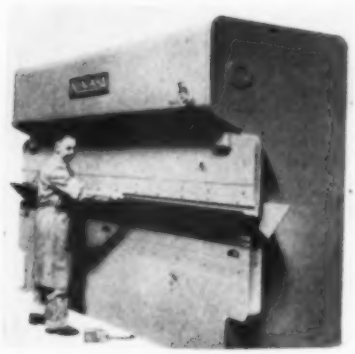
Get all the facts. Write to:

Special Products Sales

EASTMAN KODAK COMPANY, Rochester 4, N. Y.

the KODAK CONTOUR PROJECTOR

Kodak
TRADE MARK



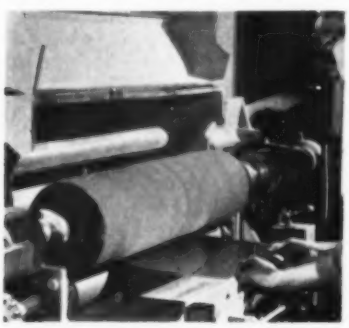
Niagara Adds 15, 60-ton Units To Inboard Press Brake Line

Redesigned 15, 30 and 60-ton models make up the expanded Niagara inboard press brake line. The one-piece all welded steel frame with integral wrap-around crown provides maximum resistance to deflection and positive alignment of bearings, bed and ram, according to the manufacturer.

Models can be furnished with either power or manual clutch-brake-treadle arrangement, depending on the size of the machine and the work to be handled. Laminated, non-metallic ways prevent welding or galling of the bearing surfaces. Mild steel bending capacities range to 3/16 in., with over all bed and ram lengths from 4 to 14 ft.

Niagara Machine and Tool Works, 68 Northland Ave, Buffalo 11, NY

MORE DATA? Circle 70, inside back cover

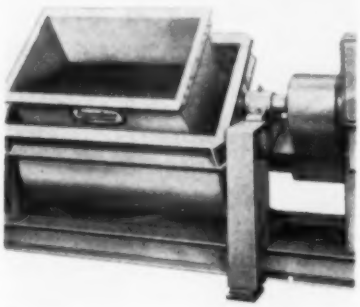


Nylon Abrasive Wheels Will Produce Special Finish Effects

Nylon fiber wheels with abrasives dispersed throughout have been introduced for cleaning and polishing metals, plastics, rubber and wood. Wheels are said to be well suited for cleaning, for making decorative straight line or swirl patterns, or for making matte finishes. They are not intended for stock removal. Wheels and rolls are made in all normal diameters, in face widths up to 60 in. and in a grit range of 100 to 600. Typical metalworking applications include polishing stainless steel sheet, blending stainless steel welds (after grinding), removing oxides from titanium, and blending leaded areas on automotive work.

Behr-Manning Co. Division of Norton Co, Troy, NY

MORE DATA? Circle 71, inside back cover



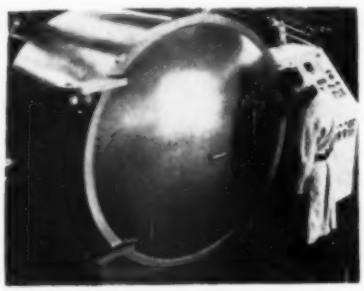
Vibrating Barrel Finisher Said To Cut Finishng Time

Vibrasheen Model VT-75 is reported to finish metal parts in a fraction of the time required by ordinary barrel finishing operations. The 5 cu ft capacity unit vibrates the entire load of parts and media, thus adding a scrubbing action.

The vibrating amplitude is adjustable in seven settings to provide from 1/64 to ¼ in. for finer finishing of delicate parts or heavy burr removal. Vibration frequency is 1800 vpm with variable frequency also available.

Almco, Queen Products Div, King Seeley Corp, Albert Lea, Minn

MORE DATA? Circle 72, inside back cover



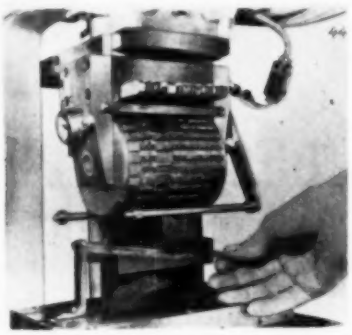
72-in Vacuum Coater Incorporates Redesigned Pumping System

Redesigned system is said to give faster pump-down to the metallizing pressure resulting in shorter coating cycles, plus greater flexibility in operation, and easier maintenance. Pumping system of the new Stokes Model 427-4 is based on a modular approach to vacuum system design. This provides both increased pumping capacity and great flexibility in operation.

Pumping system comprises two identical teams of mechanical pump, diffusion pump and booster pump; each team is connected independently to the vacuum chamber through its own high conductance manifold and high vacuum valve. Total pumping capacity of the two 16-in. Ring-Jet diffusion pumps and the two 4-in. Ring-Jet booster pumps which back them up is 22,000 cfm at 0.5 micron.

F J Stokes Corp, Vacuum Equipment Div, 5500 Tabor Rd, Philadelphia 20, Penna

MORE DATA? Circle 73, inside back cover



Name, Numbering and Lettering Head Developed for Hot Stamping

A 25 to 35 wheel numbering head developer for hot stamping also does trade-mark and name stamping in any desired combination.

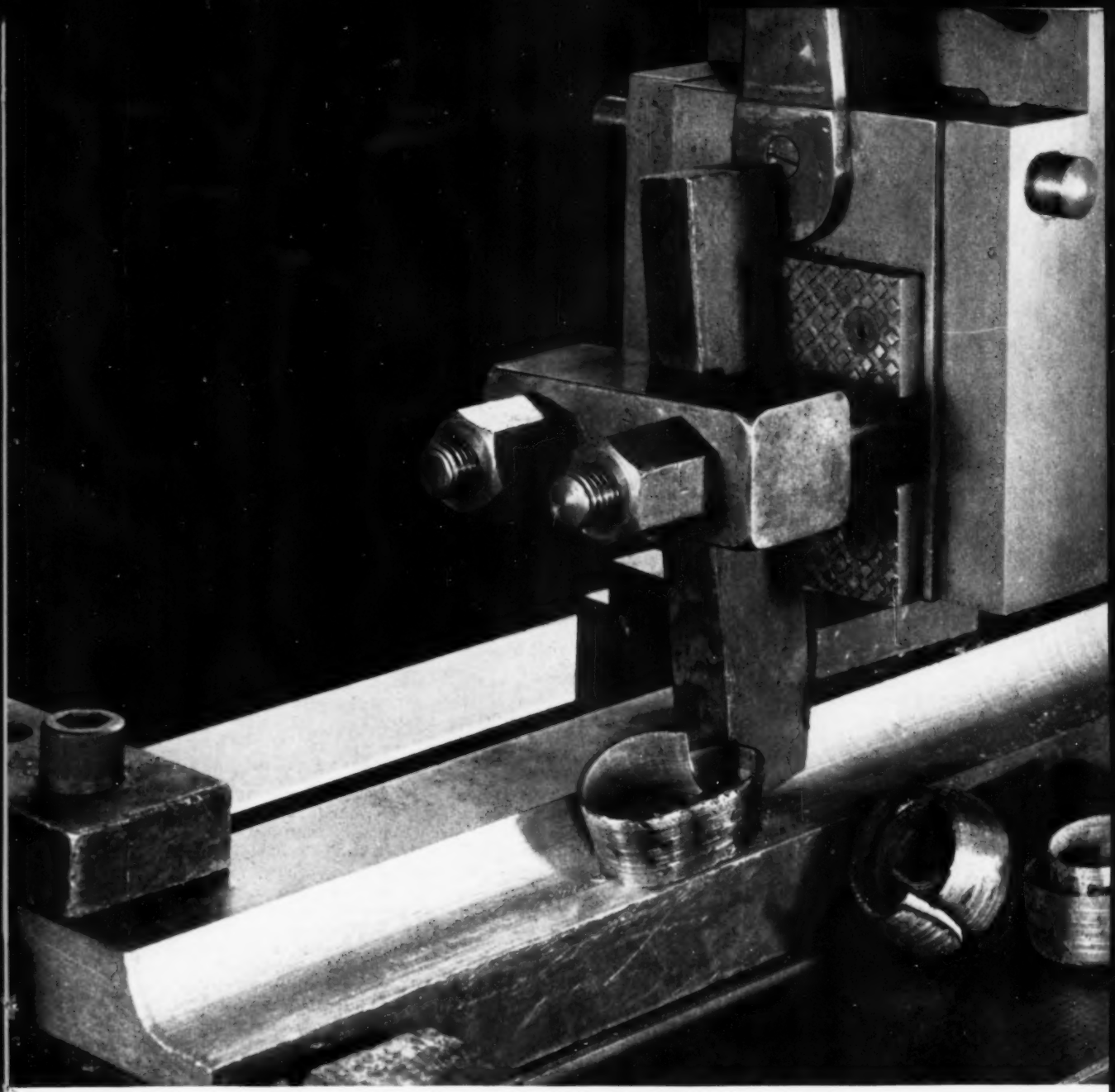
Designated the Acromark Hot Stamping Head No. 441, it is provided with thermostatic heat control to provide proper stamping temperatures. The cartridge type heating element is mounted in the center shaft and plugs into any ac line.

Index and pointer indicate the exact setting of the wheels to the operator. Wheels are released for quick setting by pressing the levers above them. Permanent lubricant treatment assures that the wheels will operate perfectly even at high temperatures.

An adjustable tape-feed guide provides for the use of roll leaf foil in any hot stamping press having automatic roll leaf feed. Overall size is 6 in. wide by 8 in. high by 6 in. deep.

Acromark Co, 7-13 Morrell St, Elizabeth, N J

MORE DATA? Circle 74, inside back cover



Machining gib for heavy duty lathe from cold rolled steel. Depth of cut: ¾", feed: .060"

The Big Cut without the Big Cost

You can pay more, but you can't buy greater power and accuracy than is yours with a reliable Smith & Mills Shaper. In fact, even if you spend thousands of dollars more, you will not obtain all the advantages that Smith & Mills offers.

Throughout continuous high speed operation, using heavy feeds and maximum power, a Smith & Mills Shaper holds limits and resists deflection. The reasons are apparent . . . Solid Ram, unequalled for heavy duty, high production work . . . Patented Self-Locking Ram Adjustment for one-step positioning (even when reciprocating) and complete backlash elimination . . . exclusive "Solid Unit" Bull Gear Assembly . . . ram, rocker arm, bull gear and other critical components made of nodular iron.

Compare . . . feature for feature . . . cut for cut . . . cost for cost! Prove to yourself that a Smith & Mills Shaper offers all the power, accuracy and versatility of the expensive shapers, yet costs hundreds, even thousands of dollars less. Write today for details and specifications.

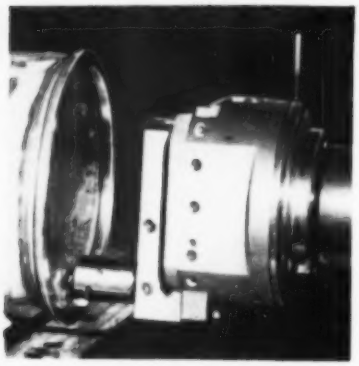
SMITH & MILLS

SHAPERS

Division of NoBEL
Machine Tool Corporation

3407 Central Parkway, Cincinnati 25, Ohio

CIRCLE 256 READER SERVICE CARD



Small-Diameter Boring Heads Have Continuous Radial Feed

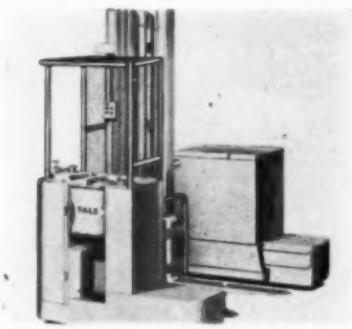
Three new continuous feed facing heads for small-diameter boring, facing, turning, counterboring, backfacing, grooving, and chamfering operations have uninterrupted radial feed and extreme accuracy.

Designed for all types of rotating-spindle machines, they cover a range of diameters from 7/16 to 25 in. Cutting diameter is controlled by the operator or by adjustable feed stops which may be preset to required diameters. Radial feed is adjustable to 0.0001 in. or finer.

The tools have 4, 6, or 10 in. dia bodies and are available with standard or special shanks for spindle mounting or with flange adapters for sleeve mounting. Other design features include: an adjustable safety clutch which releases under overload, a clamping screw for fixed slide operations, and a manually operated rapid traverse for the slide.

Davis Boring Tool Div, Giddings and Lewis Machine Tool Co, Fond Du Lac, Wis

MORE DATA? Circle 75, inside back cover



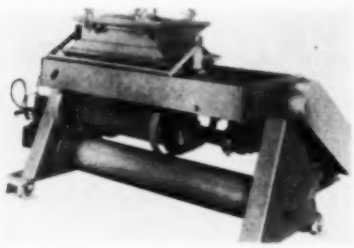
Side-Loading Electric Lift Truck Speeds Narrow Aisle Storage

This 3000-lb-capacity model of the Side-Loader is capable of stacking over 18 ft high in a very narrow aisle. Cycling time at the rack or storage position can reportedly be cut by 50% because operator doesn't have to turn the truck in a narrow space to pick up or position a load.

New Yale unit is a U-shaped machine capable of handling both very long, narrow loads, and normal pallet loads. In transit, normal loads are carried within the dimensions of the truck itself; long loads are carried on low platforms formed out of the legs of the U. In picking up or placing a load, the mast of the truck extends 26 in. hydraulically; in sequence, the forks and carriage extend 28 in., also hydraulically. Combined movement places forks and load 12 in. beyond the outer edge of the truck. Operator stands in a compartment in one leg of the U facing on the axis of the aisle in which material is to be stored.

Yale & Towne Mfg Co, 11,000 Roosevelt Blvd, Philadelphia 15, Penna

MORE DATA? Circle 76, inside back cover



Vibrating Tumbling Barrel Speeds Precision Finishing

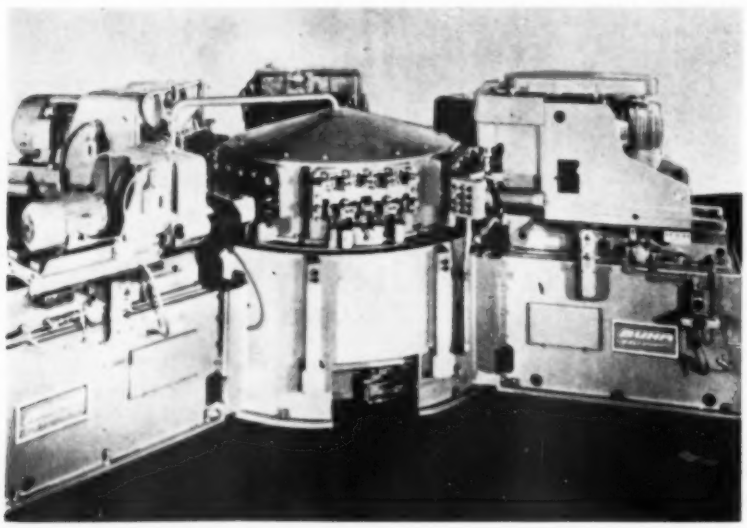
Lorco Vibrator, 15-hp Model 1930E, is said to operate from 10 to 100 times faster than tumbling barrels of comparable capacity. It will clean, descale, deburr, radius, fine finish, color, burnish or ball burnish metal, wooden, or plastic parts.

Media, compound, and water are required as with conventional tumbling if a wet process is used. Load of parts and media rotates as a mass; additional scrubbing action between load constituents is induced through controlled vibration. Both amplitude and frequency of vibration can be controlled so that the unit can perform everything from coarse work, requiring severe cut-down, to the most delicate precision jobs. Interior finishes and finishes in shielded areas can be obtained. Bottom drain, as well as a rinse cover, allows parts and media to be rinsed and compounds changed without removal of load. Easily adjusted mechanism compensates for weight variations from extremely light to very heavy loads.

Model is 88 in. long, 42 in. wide, 48 in. high. Bowl (unlined) has volume of 6.92 cu ft. Either a constant or a variable speed motor may be supplied.

Lord Chemical Corp, 2068 S Queen St, York, Penna

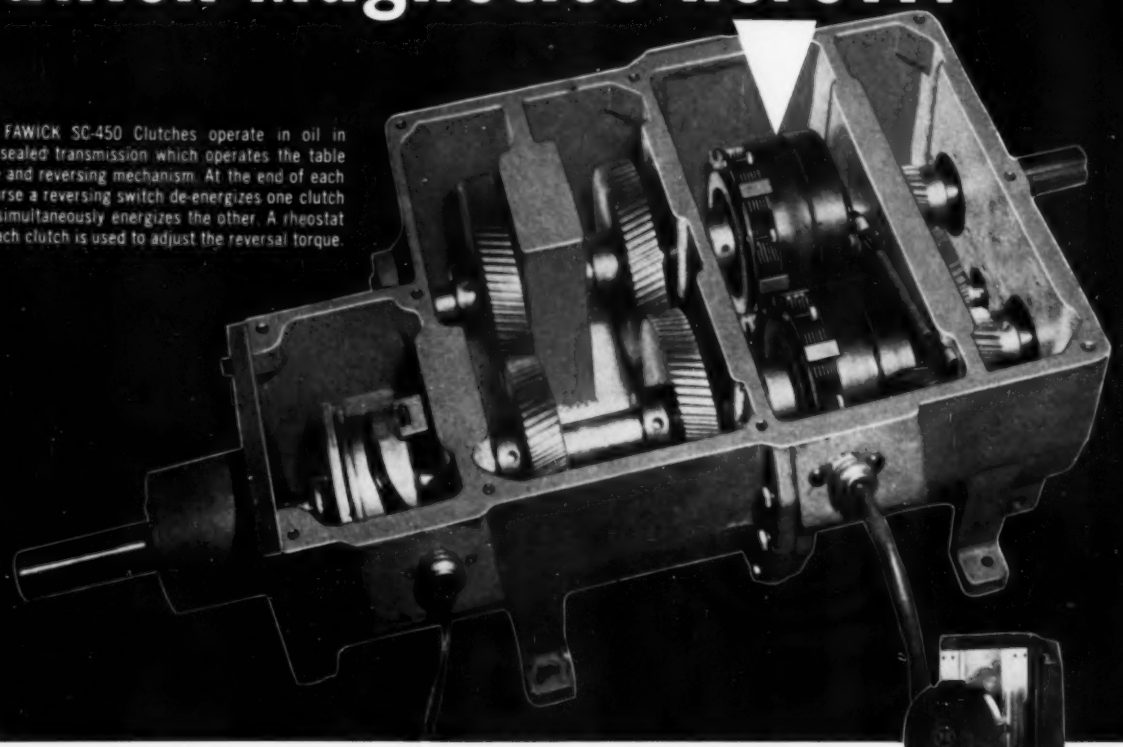
MORE DATA? Circle 78, inside back cover



TRUCK CONNECTING RODS AND CAPS are machined at the rate of 300 sets per hour at 75% efficiency on this five-way dial machine which is designed for carbide or HSS tools. Two cuts, displaced vertically, are taken in the crankpin bore to allow for metal removed when the parts have been sawed apart—*Buhr Machine Tool Co, Ann Arbor, Mich*

MORE DATA? Circle 77, inside back cover

Fawick Magnetics here...



Two FAWICK SC-450 Clutches operate in oil in this sealed transmission which operates the table drive and reversing mechanism. At the end of each traverse a reversing switch de-energizes one clutch and simultaneously energizes the other. A rheostat on each clutch is used to adjust the reversal torque.

aid high-precision surface grinding HERE!

In designing and building their Model 824 Reid-o-Matic Precision Surface Grinder, Reid Brothers Company, Inc., Beverly, Mass., utilized their fifty-seven years experience in this field to produce a machine incorporating the best possible operating features for automatic precision grinding.

An important assembly in these fine machines is the sealed table reversing transmission which provides a smooth, positive table drive at speeds variable from 5 to 90 surface feet per minute, and variable traverse lengths to 24 inches.

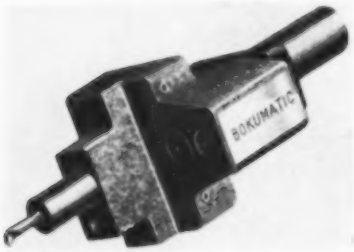
Two FAWICK SC-450 Magnetic Clutches provide this transmission with dial-controlled variable torque and shock-free reversing of the table regardless of speed or stroke length.

This FAWICK application is typical of many machine tool installations where FAWICK Magnetic Clutches provide instant, shock-free and positive controlled torque from electric or electronic controls to high-precision tools.

FAWICK AIRFLEX DIVISION
FAWICK CORPORATION
9919 CLINTON ROAD • CLEVELAND 11, OHIO
Fawick Canada, Ltd., 60 Front St., West, Toronto, Ont., Canada

FAWICK MAGNETIC
INDUSTRIAL CLUTCHES AND BRAKES

CIRCLE 257 READER SERVICE CARD



Tool Holder Speeds Internal Cutting Jobs

A new series of holders for internal cutting tools is said to simplify and speed up internal grooving, back chamfering, thread recessing and special internal forming. Holder movement consists of a horizontal, straight line entry and dovetail side action during cutting. Holders will cut as much as 0.072 in. per side for the smallest size, to 0.350 in. per side for the largest holder offered. A preset adjustment is said to eliminate wasted cutting motion, so that actual metal removal starts as much as 2 sec sooner than with conventional holders. Tools come in 6 sizes for a complete range of machines, including 200 automatics.

Bokum Tool Co, 14755 Wildemere Ave, Detroit 38, Mich

MORE DATA? Circle 79, inside back cover

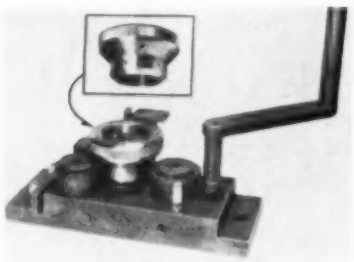
German Draco Speed Shear Is Multi-Purpose Cutting Tool

Two models of the Draco-Speed Shear are available: one for cutting of light metal up to ⅛-in. and sheet iron up to 3/64-in. thickness; the other for cutting plastics and fibrous materials.

Shear can be attached in a few seconds to any make of electric hand drill or motive power unit which transmits through a chuck, including flexible drives and high-speed drilling machines. It will cut any shape of pattern, including tubular work, without distortion or straightening. No edge finishing is required. A curved or straight pattern can be started in the middle of the sheet; only a ⅜-in. hole is necessary to insert the cutting blade. An accuracy of 2½ thousandths of an inch or less can be obtained by free-hand cutting; closer tolerances can be held by mounting the tool in a vise. Unit can be fixed into a lathe for mass production operations. Model weighs 1 lb. Cutting speed is up to 11 fpm at approx 1500 rpm.

Malden Research & Development Co, 1130 Main St, Malden, Mass

MORE DATA? Circle 80, inside back cover

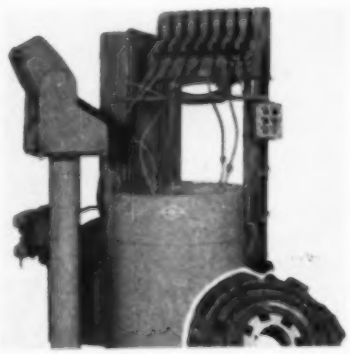


Fixture Imprints Numerals On Circumference of Metal Parts

The circumference of metal parts can be stamped with numerals or letters with this new marking device. Marker can also be adapted to make graduated markings where close tolerances are not required. Shown above, the unit is used to mark a dial handle for a fuel control valve. Depth of impression is adjustable. Mandrel includes a positioning pin to hold the part while it is being marked, and a hold-down block to keep piece from lifting during rotation. It is designated Model GRD-950-1A.

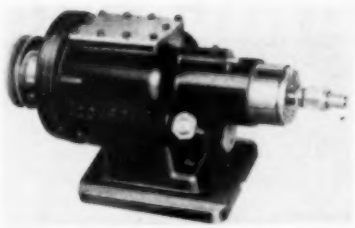
M E Cunningham Co, 1025 Chateau St, Pittsburgh 33, Penna

MORE DATA? Circle 81, inside back cover



ASSEMBLY MACHINE automatically assembles vane-type pumps from parts including springs, slippers (vanes), rotor, and pump body. Production rate is 300 pumps per hr. All controls are self-contained; operation is combination air and hydraulic—*Gray Equipment Co, 13600 Ford Rd, Dearborn, Mich*

MORE DATA? Circle 82, inside back cover



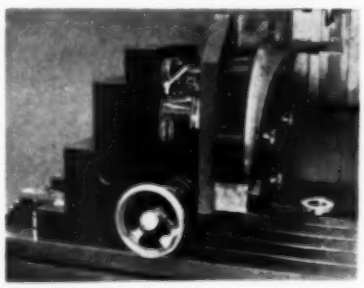
Automatic Drilling Unit Has Built-In Feed

Model KHB, in addition to its own built-in feed, incorporates an infinitely variable hydraulic rate of feed control with adjustable rapid approach to control the tool at entry and at break-through. Unit will rotate and feed the tool into the work when motor is turned on, and will withdraw when motor is turned off. Accurate depth will be held as the unit will dwell against a positive stop at end of stroke.

For operation, Model KHB is mounted on a plate and driven by an electric motor through a belt drive. Several units may be run from one pushbutton or even one motor, if belting is so arranged.

Govro-Nelson Co, 1931 Antoinette Ave, Detroit 8, Mich

MORE DATA? Circle 83, inside back cover



Black Granite Angle Plate is Accurate to 0.5 Sec

Angle plates accurate within ½-sec are now being made by Kahn Surface Plate Co. Plates are constructed from black granite, due to the stone's stability, which is said to assure against loss of accuracy. Shown in the photo is a granite right-angle plate measuring 12 x 12 x 18 in., used to support a precision rotary table for producing low tolerance computer parts. Rotary table is bolted to granite plate at top, fastened with threaded inserts at bottom. Large hole at center of gravity of plate allows use of a carry-bar when plate is moved.

Kahn Granite Surface Plate Co, 614 N Western Ave, Dayton 7, Ohio

MORE DATA? Circle 84, inside back cover

CIRCLE 258 READER SERVICE CARD

Photo Courtesy Waukesha Motor Company

...ON A DIME, GENTLY!

WHEN CLOSE SPOTTING IS THE NEED, P&H ZIP-LIFT IS THE STANDARD.

P&H Zip-Lift hoists excel in their ability to spot delicate loads on a dime, quickly — but gently. That's why you'll find Zip-Lifts aplenty . . . hanging over every vital lifting area . . . in this engine manufacturer's plant.

Why Zip-Lift?

First: Zip-Lift is *close-spotting*. Precision spotting of even awkward loads is done with the touch of a button. One hand control operation leaves other hand free to guide the load right to the spot.

Second: Zip-Lift *always works*. Its consistent dependability has been proven in tens of thousands of applications and under the toughest working conditions.

Third: Zip-Lift is *safe*. Workers are protected by a complete line of safety features including dual brakes, shrouded load block, low 24 volt control, and two limit switches that protect worker, load and hoist.

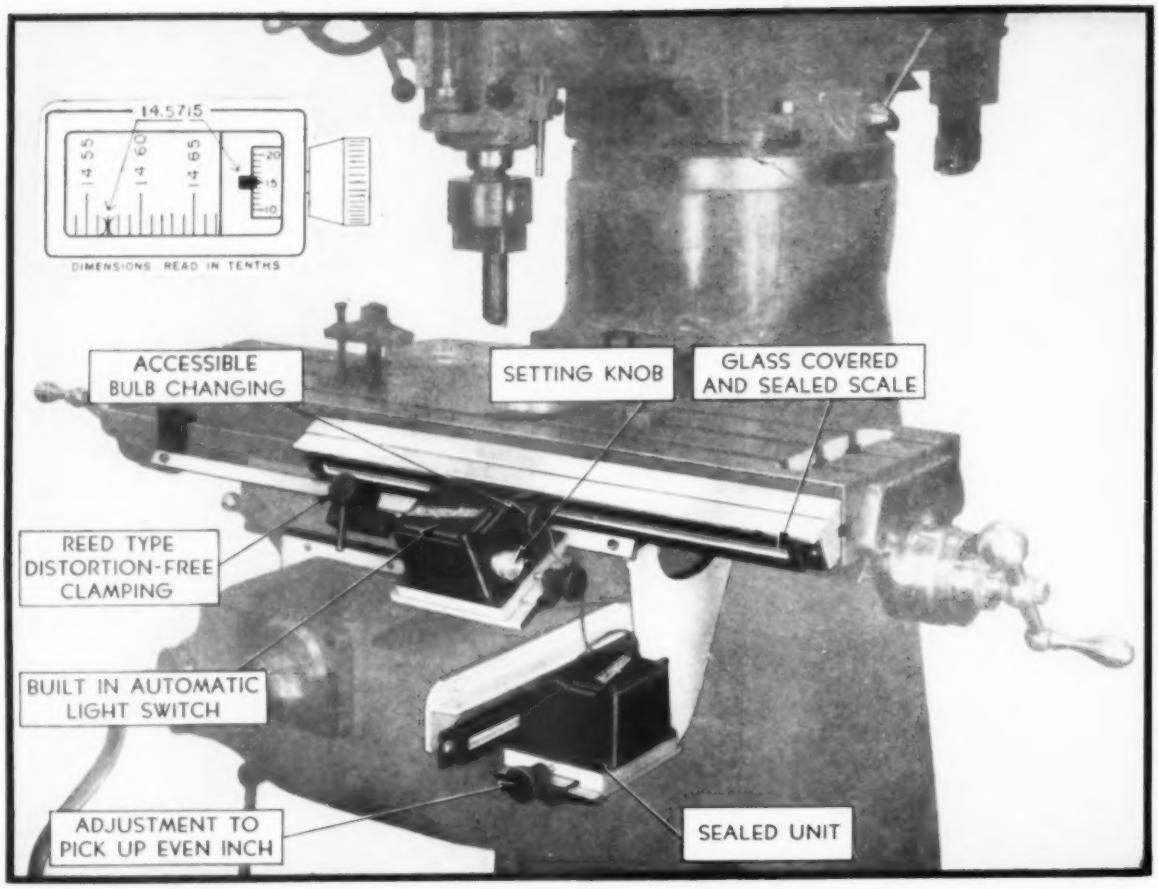
Best of all, Zip-Lift is *priced right* — at no sacrifice of quality.

The complete story on Zip-Lift is yours for the asking in Bulletin H-20. Write Dept. 204, Harnischfeger Corporation, Milwaukee 46, Wisconsin.

OUR 75TH YEAR

P&H HARNISCHFEGER

...quality and service for 75 years



Do you find this sort of Versatility in any other machine in your shop?

For example . . . consider the new BRIDGEPORT Optical System. Here's what it accomplishes in terms of speed, accuracy and efficiency: ability to read a figure on the scale just as it appears on working drawing. No vernier estimations, no special operator skill; table can be quickly positioned in both planes.

Other attachments available for the BRIDGEPORT provide versatility in milling, drilling, boring and shaping at any angle without change in set-up.

The best evidence we can offer of versatility is this: practically every BRIDGEPORT we've sold is the first of several installations in the same shop. Actual figures point to 20,000 customers who are using over 45,000 machines. We know of no other machine which gives this kind of acceptance through versatility, economy and quality. Do you?

Consult us or your nearest dealer for further details.

Bridgeport MACHINES, INC.
Bridgeport, Connecticut
Manufacturers of High Speed Milling Attachments and Turret Milling Machines

"We just changed our steel supplier"

"For 18 years we bought our steel from the same people. But with a string of new products, we had trouble getting the types we needed. Saw an ad recently that looked like an answer. Showed it to some of the boys on the Purchasing Committee and found they'd noticed it too. We got the salesman in and the new set-up has cut down steel supply troubles."

Among hard-to-reach Metalworking production men like our typical but hypothetical Mr. Schlictmann, that's frequently the way sales start. With so much buying handled by committee action, it's a problem to keep in contact with this group. In today's changing technology, you do this best in the technical publications these men read.

With Metalworking production management, this is usually American Machinist. Written and edited for production engineers and executives in Metalworking, it's consistently regarded as the "most useful" publication in the field. Thus, more of them subscribe to it than any other Metalworking publication. That's why so many Metalworking men tell you . . .

"I have to read American Machinist"

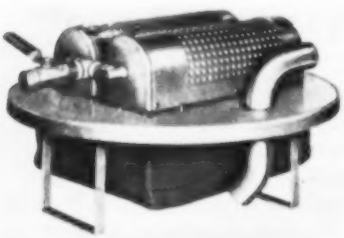
McGraw-Hill Magazine of Metalworking Production
330 West 42nd Street, New York 36, New York

Balancer Adjusts Grinding Wheels in 30 Minutes

New Aero balancer make fast, accurate balancing of grinding wheels possible without removing the wheel from the grinder. Portable balancer makes savings up to 80% possible in grinding operations, according to the manufacturer. Balancer is said to achieve precision balance within 30 min from time wheel is turned off. A set of three adjustable weights inserted in the hub, with two balance screws making micrometer adjustments of the weights, makes the fast balance possible.

Aero Supply Mfg Co Inc, Corry, Pa

MORE DATA? Circle 85, inside back cover



Bulk Material Pickup Unit Has Double Air Volume and Velocity

Vac-U-Max Twin-Jet material pickup unit is said to combine the high suction power of standard single jet units with doubled air volume and velocity at the suction nozzle.

Designed for use on both wet and dry materials, the unit can pickup such things as heavy metal chips, nuts, bolts, sludge, lead grindings, solder spills, and punchings. Because it is operated entirely by air, with no motors or moving parts, it is reported to be suited for such hazardous applications as pickup of explosive dust or radioactive materials.

Standard units have two venturis in parallel. They operate with ½-in. air line and hose, ¾-in. for long runs. Units, which fit any 55-gal drum, draw 280 cfm air at a velocity of 11,500 fpm through a 2-in. hose. High velocity models using larger venturis provide 600 cfm air flow at a velocity of 12,000 fpm through a 3-in. hose.

Vac-U-Max, 1 Montgomery St, Belleville 9, NJ

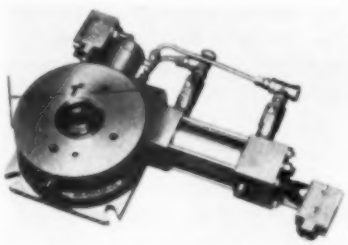
MORE DATA? Circle 86, inside back cover

Tumb-L-Matic Introduces New Barrel Finishing Unit

Barrel finisher is designed especially for deburring small metal stampings, ball-burnishing jewelry parts, and deflashing plastic parts after molding. The hexagonal barrel is 14 in. wide and 15 in. long, and is lined with ¼-in. neoprene. A ¼-hp motor drives the finisher with speeds adjustable from 15 to 45 rpm. A work and compound separation system is designed into the machine.

Tumb-L-Matic Inc, St Mary's St, Stamford, Conn

MORE DATA? Circle 87, inside back cover



Miniature Index Table Will Handle Work Up To 100 Pounds

Able to make up to 75 indexes per minute, this 7-in. index table is available with 4, 6, 8 or 12 stations standard, or up to 24 stations to order. Essentially a smaller version of Air Hydraulics' line of larger index tables, it handles work up to 100 lbs and incorporates most of the features of the larger models. Overriding is prevented on the forward stroke by controlling the indexing cylinder with a non-adjustable stop rod. Return stroke is controlled by an adjustable stop. In addition, the indexing cylinder is equipped with an adjustable air cushion and adjustable speed control. Table is locked in position accurately within 0.0015 in. This locking mechanism incorporates a limit switch which prevents auxiliary equipment from moving into position until table is locked securely. An additional limit switch is optional for controlling more complex setups with many stations.

Air Hydraulics Inc, 202 Hupp Ave, Jackson, Mich

MORE DATA? Circle 88, inside back cover

Wire Rope Electric Hoists Offered in New Heavy-Duty Line

Balanced Design Hevi Lift line is so named because each part of hoist's motor, gear case, drum assembly, and brakes has been balanced or matched against each other for strength, temperature, and performance characteristics.

Line includes hoists with lifting capacities from 2000 to 50,000 lbs., with lug, hook, plain, hand-geared, or motor-driven trolley mountings, with standard or low headroom arrangements as well as base, wall, ceiling, and deck mountings. Powered trolleys may be had with single speed, two speed, or variable speed drives. Lifting speeds, according to model, range from a low of 10 to 20 fpm to high of 20 to 100 fpm. Heights range from 15 to 100 ft. Power arrangements include 115/230 v dc and 220/440/550 v ac, 2/3 phase 50/60 c with 24-v operating controls. Motors are available in single, two, or variable speed.

Harnischfeger Corp, Milwaukee 46, Wis

MORE DATA? Circle 89, inside back cover.

MOLYKOTE®

LUBRICANT

metalworking news

PUNCH LIFE INCREASED FROM 2,000 to 25,000 HOLES IN STEEL PLATE

These punches (11/16") were used to punch 25000 holes in ½", 1020 cold rolled steel plate. Without MOLYKOTE Lubricants a maximum life of only 2000 holes could be obtained.

A West Coast manufacturer was experiencing low punch life with the best conventional lubricants. Their multiple punching operation consisted of cold shearing 50 holes simultaneously in a single steel plate. A maximum life of 2,000 holes per punch was obtained with ordinary lubricants.

Then, MOLYKOTE Type G was applied to the punch occasionally. The result: punch life was increased from 2,000 to 25,000 holes which afforded substantial savings.

When writing, refer to Item 508

"A LITTLE BOTTLE FOR A BIG JOB"

- For Extending Die Life.
- For Preventing Metal Pickup.

Try it . . . Order a 10 ounce container of MOLYKOTE Type Z TODAY!

When writing, refer to Item 507

MOLYKOTE CANNOT BE SQUEEZED OUT REGARDLESS OF PRESSURES; EXCELS AS COLD-FORMING LUBRICANT IN METALWORKING

Distortion, Stick-Slip and Fretting Eliminated • Mounting Loads Reduced • Chatter and Noise Avoided • Allows Easier Disassembly

In metal forming the most difficult problem to overcome is scuffing from metal pickup on the dies. Direct contact of bare surfaces of a piece undergoing formation with the die often results in galling, scuffing, etc. If the surfaces can be separated by a lubricant of sufficient film strength, metal pickup does not occur.

Before new dies are used, burnish them with MOLYKOTE Type Z. If the lubricant you are now using does not have sufficient film strength and galling does occur, use MOLYKOTE on your dies.

The automobile industry which forms and fabricates vast tonnages of various metals, uses MOLYKOTE Type Z extensively.

When writing, refer to Item 505

Applying MOLYKOTE Lubricant to feed stock at the Bassick Company, Bridgeport, Conn., in a forming operation.

DAMAGE DUE TO IMPROPER MACHINERY "WEAR-IN" CAN BE ELIMINATED WITH NEW COMPOUND

Wear-in damage is often serious enough to require costly reconditioning of new equipment and if the damage is not repaired, it will interfere with and reduce the useful service life of expensive machinery. During this critical wear-in period, damage due to galling, scoring, tearing, scratching, excessive abrasion and seizing is an inherent hazard. MOLYKOTE WEAR-IN COMPOUND is the most effective lubricant yet developed to combat this damage.

In seven different ways, MOLYKOTE WEAR-IN COMPOUND saves you time and money:

1. **Shortens "wear-in" period without use of abrasives.**
2. **Reduces galling, seizing and excessive wear during the critical "wear-in" period in new or rebuilt machinery and after the installation of replacement parts.**
3. **Offers the best safeguard against costly reconditioning work and shipping delays due to the "breaking-in" of new machinery.**
4. **Eliminates "stick-slip" behavior and resists galling and seizing at bearing pressures far beyond the yield point of any metal.**
5. **Specifically designed for "wear-in" use. MoS_2 particles make intimate contact with bearing surfaces. Will not scrape off.**
6. **Need not be burnished into surface. Brush or wipe on a thin coating.**
7. **Inexpensive . . . a little goes a long way.**

When writing, refer to Item 506

Address your letter to The Alpha-Molykote Corp., 65 Harvard Ave., Stamford, Conn.
Phone: FIreside 8-3724.

SEE OUR CATALOG IN SWEET'S

THE ALPHA-MOLYKOTE CORP.
Stamford, Connecticut
Please send me details on

Item 505 ☐ Item 507 ☐
Item 506 ☐ Item 508 ☐

Name .....
Company .....
Address .....
City .....
State .....

THE ALPHA-MOLYKOTE CORPORATION

BREAKING LUBRICATION BARRIERS

. . . THROUGH RESEARCH

More Pieces COMPLETELY *finished in less time on* GOSS & DeLEEUW AUTOMATIC CHUCKERS

This machine . . . already acknowledged and accepted as a metal-working achievement, and the only standard one of its kind . . . winds up a day's operation with all parts assigned to it completely finished and with no secondary operations necessary. When fully loaded, a complete piece is finished at each index cycle. High productivity is attained with simple tooling.

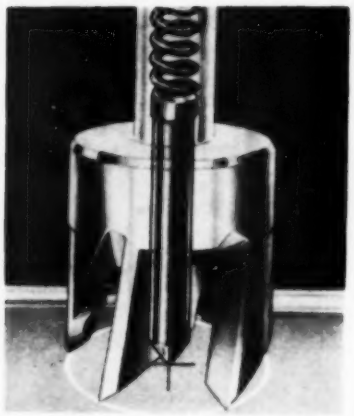
The "1-2-3" exclusive Goss & DeLeeuw feature provides for finishing machining three ends of a part simultaneously or in sequence. All operations are performed in a single set-up, and complete finishing done in much shorter time than by conventional methods.

•

Send for illustrated literature which fully describes this recent Goss & DeLeeuw development in chuckers. Submit samples of your work for time and cost estimates.

GOSS & DeLEEUW — PRODUCT QUALITY

GOSS and DE LEEUW
MACHINE COMPANY, KENSINGTON, CONN., U.S.A.

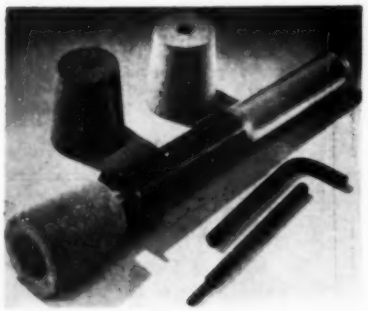


Roto-Bar Cuts Holes Without Burrs in Heavy Gage Stock

An improved Jancy Roto-Bar now cuts holes in heavy-gage stock which are accurately round and burr-free. Tool produces precision holes in either flat or cylindrical work. An axially retracting center point assures accurate positioning and eliminates the necessity of center punching or pilot drilling. On layout and template work, the tool is said to eliminate jigboring, punchpress setups and inaccuracies of sequence drilling. Stock sizes are available from 3/16 in. to 2-1/32 in. (increments of 1/64 in.) with either straight or morse taper shanks. Larger sizes made to order.

Jancy Engineering Co, 508 S Pine St, Davenport, Iowa

MORE DATA? Circle 90, inside back cover



Wheel Dresser Uses Free-Spinning Wheel

Dresser, called Spin-Kontrol, is designed with a free-spinning wheel. It is said to be particularly useful for processing diamond wheels; by its spin-controlled crushing effect it removes bonding material and exposes the diamonds without tearing them from the wheel. Unit revolves instantly on contact, making it easy for the operator to form a radius on

250,000 Power Tools per year with Cities Service Pacemaker T

Porter-Cable, one of the world's largest manufacturers of portable wood-working tools, has long known the value of quality in a lubricant as well as in a power tool. Each piece of equipment made by Porter-Cable is carefully pretested before manufacture and then continually tested for years after its original appearance on the market. It is this kind of thoroughness that led to Porter-Cable's choice of Cities Service Pacemaker 300 T as the hydraulic oil to power their Fostermatic Screw Machines and Landis Grinders.

But Cities Service Pacemaker T is more than a hydraulic oil . . . it is a multi-purpose line of lubricants suited for many applications. Porter-Cable also uses Pacemaker 300 T for lubricating valves in the plant's compressors. Pacemaker T can be used to lubricate bearings, diesel engines, electric motors, generators, reduction gear drives, turbines and in circulating systems.

Pacemaker T is available in various viscosities to give you one line of quality lubricants that can save costly warehouse space by simplifying your inventory . . . cut maintenance costs and extend equipment life. These oils have high viscosity index, excellent heat resistant properties and are chemically fortified against oxidation, corrosion, rust formation and foaming.

Contact your nearest Cities Service office and an experienced Lubrication Engineer will call to make specific recommendations for your plant on the use of Pacemaker T. Or for further information, write: Cities Service Oil Company, Sixty Wall Tower, New York 5, N. Y.

CITIES SERVICE

QUALITY PETROLEUM PRODUCTS

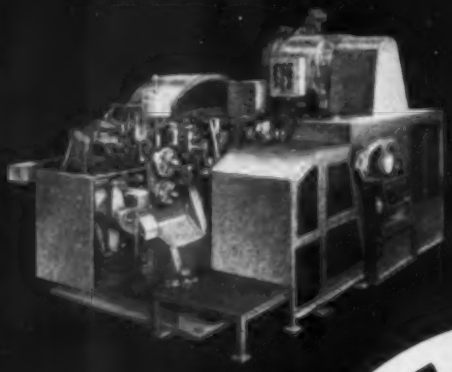
Porter-Cable Machine Company
Syracuse, New York

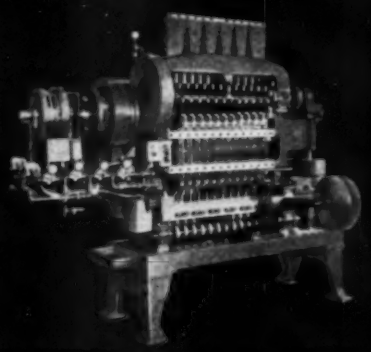
Porter-Cable Research Engineer testing engine for new lawnmower the company will produce soon. All new products undergo extensive research and testing before production.

Backbone of Production Line is Automatic Screw Machine. Pacemaker T gives outstanding performance as hydraulic medium in these machines as well as in Landis grinders and as a general lubricant!

CIRCLE 263 READER SERVICE CARD

COLD HEADING MACHINERY



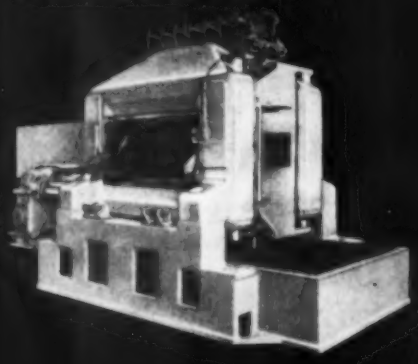


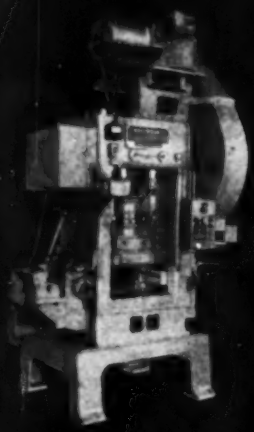
EYELET, SLITTER & WIRE MACHINERY

WATERBURY FARREL

MACHINERY BUILDERS

ROLLING MILL MACHINERY





POWER PRESSES

THE WATERBURY FARREL FOUNDRY & MACHINE CO.

DIVISION OF TEXTRON INC

Waterbury, Connecticut, U.S.A.

Sales Offices: Chicago • Cleveland • Los Angeles • Millburn, N. J.

a grinding wheel quickly and to a sharp angle without breaking it down along the edge. Flying chips are reportedly held to a minimum.

Dresser is furnished with three wheels, one each for dressing diamond wheels, coarse grit, and fine grit wheels. Set also includes an Allen wrench and a drift pin.

Jarvis Corp, Middletown, Conn

MORE DATA? Circle 91, inside back cover

Micro-Tool Speeds Turning, Boring or Facing Operations

This new cutting tool and holder is useful for applications requiring individual adjustments for each turning, boring or facing operation. Adjustments are simply made by turning one of two calibrated nuts on either side of tool holder. This tool is said to reduce the machining cycle of combination rough and finish cuts, and to reduce number of machines needed to turn parts with many diameters and shallow steps. Tools are available in solid high speed steel, and tungsten carbide inserts or "throw-aways."

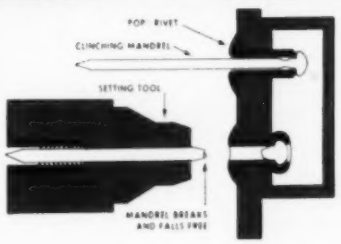
Micro Tool Division, James Engineering and Machine Co, 2451 Monroe Blvd, Dearborn, Mich

MORE DATA? Circle 92, inside back cover

"He's absolutely worthless as a worker . . . Isn't there someplace for him in supervision?"

"POP"®
RIVETS
SAVE THE SURFACE

Assemble finely finished wood chair panels, enameled or painted metal sheets, "POP" Rivets save the surface. Setting tools can't slip. Burrs on fastener head and countersinking are eliminated.



HOW THEY WORK – "POP" Rivets are assembled on a precision high-tensile mandrel. Mandrel head is drawn into the reverse side of rivet with a setting tool. Mandrel head breaks off under tension clinching the rivet. Work is squeezed by compression – controlled radial expansion. Setting tools from $18 to $300.

"POP" Rivets set by compression without the turning action which tears the surface finish allowing corrosion to start. Fasten sheets as thin as .020 dead soft aluminum or 24 gauge steel without distortion. Use thinner materials without creating a fastener problem.

"POP" Rivets install and set from same side. Get this design advantage for your product. Set up to 1,000 an hour with unskilled help. 50% savings in installed fastener costs suggest your immediate investigation.

"POP" RIVET DIVISION
UNITED SHOE MACHINERY CORPORATION
RIVER ROAD, SHELTON, CONN.
REgent 5-3391

UNITED "POP"® RIVETS

Takes performance guesswork out of power transmission design

With these performance-proved units, you can save time and money in designing and building clutches and brakes exactly tailored to the requirements of your application. At the same time, you can be sure that they will equal the performance and smooth operation of proved MAXITORQ clutches and brakes. DISC-PACS are simply the "heart" of a clutch or brake . . . the discs, separator springs, and locking plate . . . supplied as a complete self-contained unit for the convenience of design engineers and equipment builders.

Produced in a full range of sizes and capacities from ¼ h.p. to 15 h.p. Bulletins available on other MAXITORQ products: Floating Disc clutches and brakes, Electric clutches, Overload Release clutches, low-cost Single Disc clutches, and clutch or brake friction discs. Write Dept. AM-4.

THE CARLYLE JOHNSON MACHINE CO.
Manchester, Connecticut

TCJ59

Lightweight, Portable Air Hoists Introduced by Ingersoll-Rand

The 1000-lb capacity hoist weighs 39 lbs and lifts its rated load at 45 fpm; the 2000-lb unit weighs 56 lbs, lifts at 22 fpm. Aluminum alloy housing on Size MR and ML measures 12½ in. in overall length, 5¼ in. in dia.

Features include a mechanically operated brake that is automatically applied whenever the controls are released. If air supply should be shut off, lowering of the load can be controlled by the brake. Safety up-and-down stops prevent damage from overrun of the chain in either direction. Rotary throttle valve operated by a control arm shaft mounted on needle bearings gives graduated control for acccurate spotting of the load.

Ingersoll-Rand Co, 11 Broadway, New York 4, NY

MORE DATA? Circle 93, inside back cover

Self-Centering Gage Checks Bores As Small As 0.060 in.

Mahr dial bore gages are now available for checking bore sizes as small as 0.060 in. Instrument will check bores for size, roundness, and taper in every spot and to any depth within its range to an accuracy of 0.000050 in. A spring-loaded bridge, with cradle-shaped ends which form an equal-sided triangle with the

Don't guess . . . buy bearings only from Authorized Distributors . . .

We are authorized distributors for all the many lines of bearings and bearing accessories we sell — Bearings, Inc., with the manufacturer, guarantees every bearing we deliver! Avoid surplus or shelf-worn bearings — Get the bearings incorporating the latest design and metallurgical improvements — in the makers' original sealed boxes — from Bearings, Inc. You can then be certain you're getting the longest bearing life for your money.

Our bearing engineers know the answers to most bearing problems. A call to the nearest Bearings, Inc. branch, day or night, will bring one of these experts "on the double".

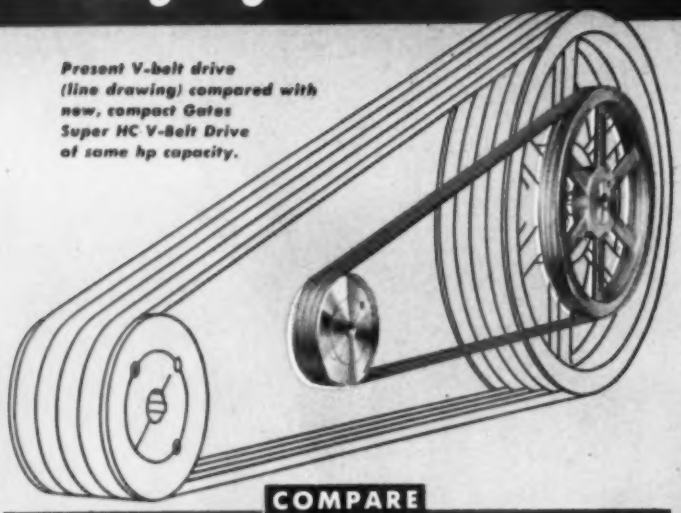
Providing bearing service in the North ➤ **BEARINGS, INC.**

OHIO: Akron • Canton • Cincinnati • Cleveland • Columbus • Dayton • Elyria • Hamilton • Lima • Lockland • Mansfield • Toledo • Youngstown • Zanesville
INDIANA: Ft. Wayne • Indianapolis • Muncie • Terre Haute • **PENNSYLVANIA:** Erie • Johnstown • Philadelphia • Pittsburgh • York
WEST VIRGINIA: Charleston • Huntington • Parkersburg • Wheeling • **NEW JERSEY:** Camden
NEW YORK: Balanrol Corp., Buffalo • Niagara Falls • **MARYLAND:** Baltimore • **DELAWARE:** Wilmington

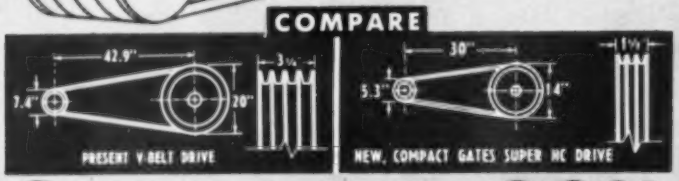
and in the South ➤ **DIXIE BEARINGS, INC.**

FLORIDA: Jacksonville • **GEORGIA:** Atlanta • **KENTUCKY:** Louisville • **LOUISIANA:** Baton Rouge • New Orleans
N. CAROLINA: Charlotte • Greensboro • **S. CAROLINA:** Greenville • **TENNESSEE:** Chattanooga • Kingsport • Knoxville • Nashville
VIRGINIA: Richmond

Designing NEW DRIVES?



Present V-belt drive (line drawing) compared with new, compact Gates Super HC V-Belt Drive of same hp capacity.



Save up to 20%

with new high capacity V-belt drive

When you change the whole drive — both V-belts and sheaves — remember: The cost of a Gates Super HC V-Belt Drive is as much as 20% less than the cost of present V-belt drives of the same horsepower capacity.

A development of Specialized Research in the world's largest V-belt laboratories at Gates, the new Super HC V-Belt makes possible the most compact, lightest-weight, lowest-cost multiple V-belt drive you can put on any machine!

Cuts drive space as much as 50%

With Gates new Super HC V-Belt, sheave diameters and widths can be reduced 30% to 50%, center distances 20% and more. Bearing load is lightened and total space occupied by the drive may be cut as much as 50%.

"The Modern Way to Design Multiple V-Belt Drives" is an informative handbook on the Super HC Drive, available from your nearby Gates Distributor listed in the Yellow Pages of your phone book.

The Gates Rubber Co., Denver, Colorado
Gates Rubber of Canada Ltd., Brantford, Ont.
World's Largest Maker of V-Belts

TPA 439

Gates SUPER HC V-BELT Drives

feeler head, centers the instrument automatically inside the bore.

To determine bore diameter, the instrument is rocked along the axis so that the contact points traverse a line at a right angle to the axis. The maximum reading of the indicator hand corresponds to the correct diameter of the bore. A sensitive comparator gaging head with shockproof movement, fully jewelled, and a total range of ± 0.002 in. is used as the amplifying unit.

The gage line covers a range from 0.060 to 10 in. with prices starting at $105.

Mehr Gage Co, Inc, 274 Lafayette St, NY 12, NY

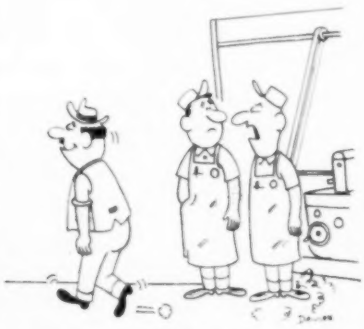
MORE DATA? Circle 94, inside back cover

Barrel Finishing Media Processes Zinc Die Castings

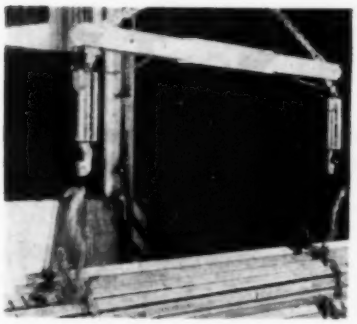
Honite brand Z-N Tumbling Shape has fast cutting rate, thus reducing barrel time. It reportedly produces a finish so fine that hand buffing is often unnecessary in the preparation of a pre-plate finish. Slough suspending chip atcion allows workpices to come out cleaner and brighter. Light weight of the media protects work against surface impingement; fracture resistance minimizes lodging problems. Present media shape is that of a truncated pyramid.

Minnesota Mining & Mfg Co, 900 Bush Ave, St. Paul 6, Minn.

MORE DATA? Circle 95, inside back cover



"That's all he can think about, . . . PRECISION! . . . PRECISION!"



Solenoid Chain Release Promotes Handling Safety

Solenoid chain release promotes safety where conditions make it dangerous for a worker to unhook a load manually. Release mechanism finds application where bars, tubes, strips and similar materials are transported by sling chain. Unit is remotely controlled by crane operator from cab by pushing a button, then solenoids expel chain from hooks. The load cannot be released accidentally—tension must be released from the chain before the solenoids become operative. Device is available in single or double spreader bars.

American Chain and Cable Co Inc, 929 Connecticut Ave, Bridgeport 2, Conn

MORE DATA? Circle 96, inside back cover

"Speedicut Chipbreaker" Cuts Drilling Costs, Ups Production

From 50% to 400% faster feed plus more holes per regrind are claims for new "Speedicut Chipbreaker." Deep hole penetration, up to 12 times drill diameter, is possible without withdrawal. Long, spiral chips are eliminated, permitting coolant to flow freely to the point of the drill. Designed for single or multiple spindle operation, "Chipbreaker" comes in sizes from ¼ in. to 4 in. Price is in line with conventional drills.

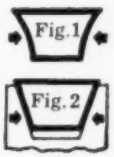
Speedicut Division, Chicago Heights Steel Co, Chicago Heights, Ill

MORE DATA? Circle 97, inside back cover

Improved Gates Vulco Rope gives you 2 important advantages

1. 40% higher hp rating at no increase in price: This important cost-saving advance is the result of Specialized Research in the world's largest belt-testing laboratories at Gates. **As replacements on standard drives these V-belts with 40% more load-carrying ability give longer service life...reduce down-time, cut belt replacement costs.**

2. Concave Sides (U. S. Pat. 1813698): The sides of Gates Belts are concave (Fig. 1). When the belt is bent around the sheave, the concave sides fill out—become straight—for full, uniform contact with the sides of the sheave groove (Fig. 2). Uniform contact insures maximum pulling power...even distribution of wear...longer life.



Available in all sizes from your nearby Gates V-Belt Distributor listed in the Yellow Pages of your phone book.

When designing new drives
use Gates new Super HC V-Belts and Sheaves.
See opposite page.

The Gates Rubber Co., Denver, Colorado
Gates Rubber of Canada Ltd., Brantford, Ont.

World's Largest Maker of V-Belts

Gates

TPA 432

Gates Hi-Power VULCO ROPE V-Belts

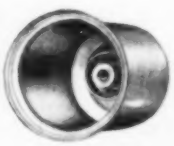
MUELLER BRASS CO. OFFERS 7 WAYS TO PRODUCE YOUR PART

Mueller Brass Co., because of its diversified manufacturing facilities that encompass a wide range of fabricating methods, is in the unique position of being able to offer you, the purchaser, an intelligent, unbiased analysis and recommendation of the best, most economical method by which your particular part can be produced. As the result of over 40 years' experience, the "Methods Analysis Department" has at its command complete knowledge of the advantages and limitations of each production process. After receiving detailed knowledge concerning the end use of the part, material specified, conditions under which it must operate and other pertinent factors, these analysis engineers make their recommendations. Every detail is considered. In many cases, methods analysis engineers recommend a simple design change that makes practical a much more economical method of production. This technical service, offered only by Mueller Brass Co., is given to each individual inquiry and is your assurance that you will get the best product at the best price . . . made the one best way . . . by Mueller Brass Co.

Send today for free technical literature on any one or all of the seven fabricating methods.

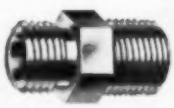
FORGINGS

Production equipment is available to produce press, hammer or cored forgings of any practical shape in sizes ranging from a few ounces to 150 lbs. in brass, bronze, aluminum and magnesium in 27 standard, as well as special, alloys.



COLD-PREST® IMPACT EXTRUSIONS

Mueller Brass Co. has complete machinery for producing Cold-Prest impact extrusions of aluminum, copper, brass, bronze and steel. Extrusions up to 28" in length are possible, depending on wall thickness and other design details. Parts can be designed having ribs, flutes, splines or bosses . . . with multiple wall diameters and with uniform or tapered wall sections.



SCREW MACHINE PRODUCTS

Mueller Brass Co. has one of the world's largest automatic screw machine departments fabricating both ferrous and non-ferrous custom parts. We can produce an infinite variety of shapes and sizes from ⅛" to 3¼" in wide range of free cutting and specialized alloys. Complete facilities for all secondary and finishing operations, as well.

POWDER METAL PARTS

Mueller Brass Co. can supply precision Sinteel® powder metal parts in wide range of sizes and metals at high production rate. Parts available from iron, brass and copper alloys. Parts may be ordered with such characteristics as self-lubrication, controlled porosity and good electrical and magnetic properties.

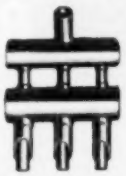
MADE IN U.S.A. TO THE STANDARDS OF AMERICAN INDUSTRY

MUELLER BRASS CO.

...and our methods analysis service helps you determine which is the best ...and most economical method

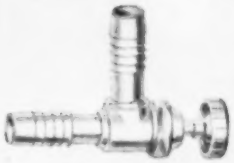
SAND CASTINGS

We specialize in the production of pressure-tight red brass castings. We utilize both metal match plate and wood patterns. Facilities include tool room and pattern shop, electric melting furnaces, high capacity core room and both bench and floor molding equipment to handle wide range of sizes.



FORMED COPPER TUBE

Mueller Brass Co. has modern facilities for forming seamless copper tube into a multitude of shapes. Forming methods used include bending, spinning, expanding or swedging, upsetting, flaring, flattening, beading and grooving, drilling and piercing, machining and joining. Formed copper tube coils are also available as single, double, spiral and serpentine shapes.



PLASTIC INJECTION MOLDING

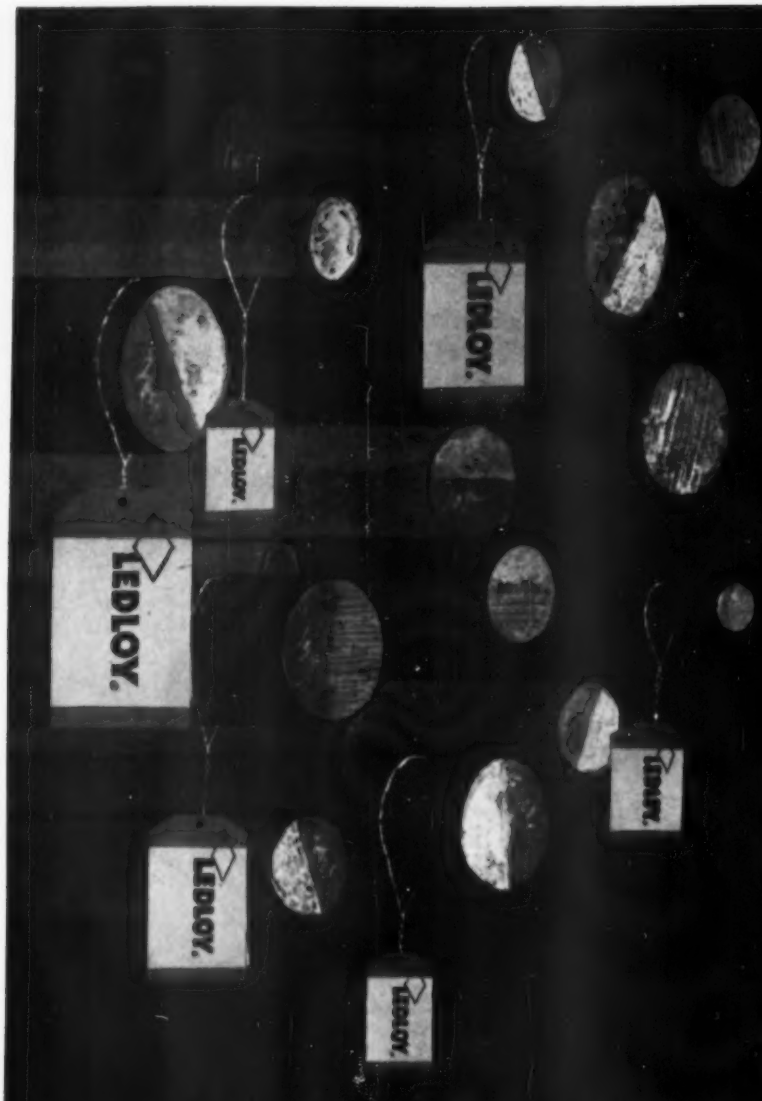
Injection molding of plastic parts is still another process offered by the Mueller Brass Co. Parts are molded from such plastics as—nylon, polyethylenes, polyvinyl chloride, styrenes, linear acetal, chlorinated polyether, polycarbonates or polypropylene, dependent on part application.

MAN FROM MUELLER BRASS CO.

Since only Mueller Brass Co. can produce your part by all these methods, only the Man From Mueller Brass Co. can give sound advice on the one best method of production. Over 40 years of research, engineering, manufacturing and marketing experience stands behind him. When you are specifying and purchasing fabricated metal parts, call in the MAN FROM MUELLER BRASS CO.

271

PORT HURON MICHIGAN



NOT ALL LEADED STEEL IS MADE BY INLAND...

BUT...

we've made more of it than anyone else . . . in fact, the first experimental heat and the first production heat of leaded steels were made in Inland furnaces.

Since then, more than 20 years ago, we've never stopped probing, refining, perfecting the process. And today we offer INLAND LEDLOY*—the leaded steels of highest quality, uniformity and dependability—the standard against which all other free machining steels are compared!

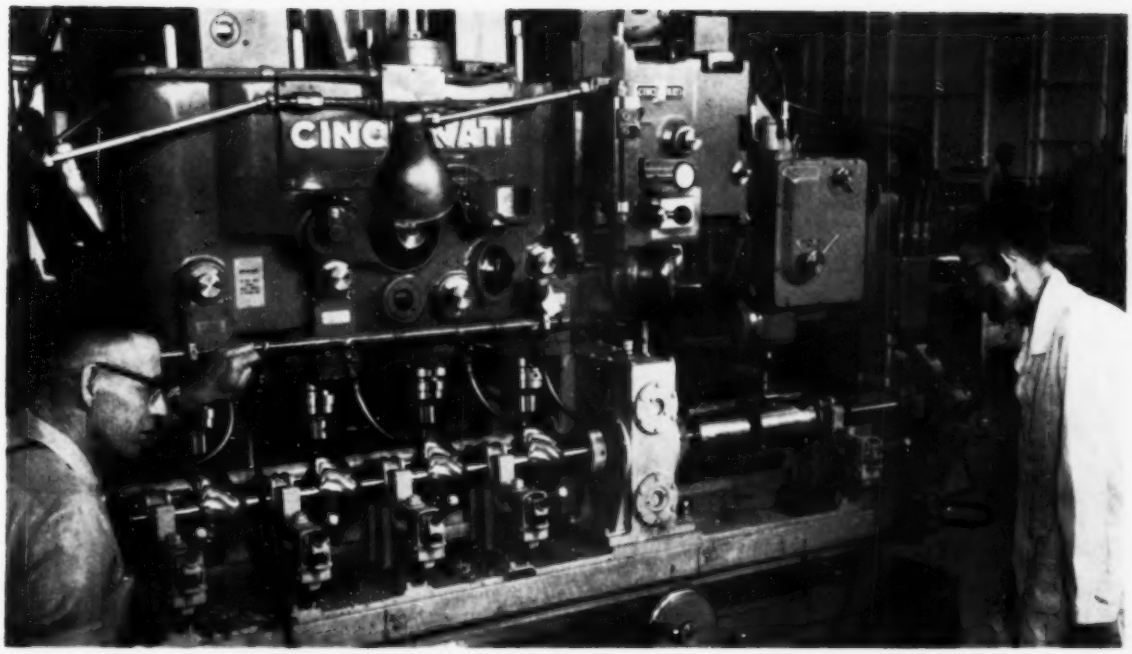
If you have any question about leaded steels . . . if increased machinability, higher speeds and feeds, easier tolerance control, greater production per tool change and fewer finishing operations sound good to you . . . we suggest you come to Inland . . . makers of LEDLOY, the original leaded steel.

INLAND LEDLOY steels are available in a wide range of standard carbon and alloy grades in bars or plates from your Cold Drawer or Steel Service Center. See them for LEDLOY and write to Inland for the booklet, "Properties of Inland Ledloy Steels".

*Reg. Trade Mark

LEDLOY *the world's most machinable steels!* INLAND STEEL *30 West Monroe Street · Chicago 3, Illinois*

INLAND *Sales Offices:* Chicago · Davenport · Detroit · Houston · Indianapolis
Kansas City · Milwaukee · New York · St. Louis · St. Paul



SEATTLE: Speeding up turbine wheel production 98% . . .

Complex multi-bladed turbine wheels, which once required 24 hours to produce, are now completed in 30 minutes with a new system developed by Boeing Airplane Co's Industrial Products Division. Formerly, it took one step to produce flat-bladed wheels; a second operation to curve the blades. Now, hydraulic controls have been added to a 3-axis self-guided milling machine to give the machine a fourth axis—a rotational feature that changes the angle of inducer blades while they are being milled. Machine turns out four wheels simultaneously, and three cams now control four motions instead of three. Cam at far right controls depth; cam in center controls horizontal table movement and roll; cam nearest the spindles controls blade angle

FIELD REPORT...

Drillmation's Drilling Service

Drillmation Co of Center Line, Mich, is offering a new laboratory and engineering service to assist companies in determining which drilling procedure—short, or deep hole—is best for a particular job. The workpiece is drilled on the new Boremation gun-bore test machine that will determine optimum feed and speeds for gun-drilling, gun-boring, gun-reaming, tube-reaming, and trepanning operations. At conclusion of test drilling, all data for a successful machining operation will have been determined—what production rate to expect, tolerances, coolant flow and pressure, feeds and speeds.

NMTBA Relocates

National Machine Tool Builders' Association has moved its headquarters from Cleveland to Washington. New quarters are located in a three-story building at 2139 Wisconsin Ave. Most of the Association's key personnel are moving to the capital.

Dana Forms New Division

Dana Corp, Toledo, has formed the Con-vel Division to handle manufacture of Rzeppa constant velocity universal joints, acquired from Gear Grinding Machine Co in May. New division is in Detroit.

$10 Million Orders to Temco

Three AF contracts totaling more than $10 million for overhaul of 284 aircraft will be carried out at Temco's Overhaul and Aerosystems Division, Greenville, Texas. Maintenance program already in progress will continue through July 1960 insuring a steady workload for the division which employs 2500 people.

S-P Buys Rocket Firm

Studebaker-Packard Co has purchased CTL Inc, Cincinnati. Founded in 1946 as the Cincinnati Testing & Research Laboratories Inc, company made the nose cones for the Army's Jupiter missiles, also produced the cone that carried Able and Baker.

Deadlier Bazooka

US Army, Marine Corps, and Convair (Pomona) Division of General Dynamics Corp have disclosed plans for joint development of Red-Eye, a new surface-to-air shoulder-fired guided missile system. Convair-Pomona has a $6 million contract for development of the new weapon, which will give combat troops the capability of destroying low strafing or bombing aircraft. The missile launcher, outwardly resembling the WW II bazooka, is 4 ft long, 3 in. in

Having PUMP PROBLEMS ?

Let Gusher Help You

On all centrifugal pump problems why not consult an expert? As the designers of Gusher (seal-less type) and Rumaco (seal type) pumps, we have the "know how" to help you with your pump problems. Just drop us a line and tell us what you want. We may have a stock model to fit your requirements. If not we may be able to adapt one easily. Remember, all Ruthman pumps are extremely low in initial cost . . . low in maintenance cost.

Model 11022
Gusher Machine
Tool Coolant Pump

Write Today for information

THE Ruthman MACHINERY CO.

• COOLANT PUMPS
• CIRCULATORS • AGITATORS
• MOLTEN METAL PUMPS

Reading Road, Cincinnati, Ohio

Field Report . . .

dia, weighs 20 lbs. It serves as a shipping container for the missile when capped at both ends. Red-Eye is a composite structure containing propellant, electronic guidance system, and a high-explosive warhead.

H&B American Machine Co . . .

. . . has dropped Machine from its name, will now be known as H&B American Corp. Stockholders at the same time approved sale of the assets of the company's Aircraft Division to US Chemical Milling Corp, Manhattan Beach, Calif.

Martin Co's Orlando Division

. . . in Florida, has a $6 million plus supplementary contract for production of Bullpup missiles for the Air Force. An additional order is expected to cover spares, launchers, and other requirements supporting the production program.

SPS Expands in Electronics

Standard Pressed Steel Co has acquired (through exchange of stock) International Electronics Industries, Nashville, Tenn, producer of miniature electrolytic capacitors.

$100 Million Steel Plant

Midwest Steel Corp, a division of National Steel Corp of Pittsburgh, is putting up the first building of a huge new steel plant in the newly incorporated Village of Portage in the Chicago area. Plant is scheduled to cost $100 million with estimated

"Well, Well! Judging by the superior toughness and humidity, abrasion and chemical resistance of this film—I'd say it was a suspension of a high molecular-weight vinyl chloride resin in plasticizer."

FORMULA FOR REDUCED ASSEMBLY COSTS

Take a low-cost fastener like Milford Tubular Rivets. Feed and Clinch with precision Milford Riveters and you multiply the cost savings inherent in tubular rivets. See Milford for all sizes, styles and finishes of tubular rivets . . . See Milford for a complete riveter line. For the answers to assembly problems *get in touch with Milford first!*

THE MILFORD RIVET & MACHINE CO.

MILFORD, CONNECTICUT • HATBORO, PENNA.
ELYRIA, OHIO • AURORA, ILL. • NORWALK, CALIF.

CIRCLE 275 READER SERVICE CARD

Only new

TURCOAT

LOW TEMP PHOSPHATING

gives you up to 200 mg/sq. ft. of zinc phosphate coating in 2 short minutes at 95° F.

The Turcoat low temperature phosphating process provides permanent paint adhesion when used at an economical, easy-to-maintain temperature of 95°F. This temperature is *lower* than that required by other "cold" phosphating processes. It is up to 75° *lower* than temperatures required by conventional phosphating processes. You save up to 75% in steam, water, electricity and downtime costs alone!

As a base for paint, the Turcoat low temp phosphating process provides a uniformly smooth coating of up to 200 mg/sq. ft. in two minutes at 95°F. **As a base for corrosion prevention,** it provides an 1100 mg/sq. ft. coating in just eight minutes at 95°F.

Turco has waited to announce low temperature phosphating until it was thoroughly perfected and proven, through exhaustive field testing, to be the very best. For this reason, you'll find that with this new process, just as with Turco's hundreds of other cleaning and chemical processes, you are assured of trouble-free operation, ease of control, and dedicated technical service...anytime, anywhere! Write today for the full story of Turcoat low temperature phosphating, along with Turco's phosphating reference chart. There's no cost . . . no obligation.

TURCO PRODUCTS, INC.

Chemical Processing Compounds

24600 South Main Street, Wilmington, California

FACTORIES: Newark, Chicago, Houston, Los Angeles, London, Rotterdam, Sydney, Mexico City, Paris, Hamburg, Montreal, Manila, Naha (Okinawa)

Manufactured in Canada by B. W. Deane & Co., Montreal
Offices in all Principal Cities

TURCO

TURCO PRODUCTS, INC.
24600 South Main Street, Wilmington, California

Please send full details on Turco's new low temperature phosphating process and Turco's phosphating reference chart, without cost or obligation.

NAME_____ TITLE (OR DEPT.)_____

FIRM _____

ADDRESS _____

AM

If you apply fluids...

DeVilbiss automatic spray assures control and uniformity not possible by any other method

Whether you're finish-coating products of any size or shape . . . applying adhesives, lubricants, glazes . . . or marking, stenciling, surface treating . . . it's time you investigated the DeVilbiss automatic spray method for your process.

With DeVilbiss automatic spray guns, you eliminate coating variations common to other methods; material use is constant; production rates are fast and uniform; and costs substantially reduced.

What's more, you can know in advance, without charge or obligation, the exact economies of automatic spray. We will simulate your operation in our fully equipped DeVilbiss research laboratory. Your supervisors are invited to be there. The results are passed along to you. Why not contact your nearest DeVilbiss representative, or write us in Toledo for all the facts.

THE DEVILBISS COMPANY
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FOR BETTER SERVICE, BUY
DEVILBISS

OVENS • DUST COLLECTORS • INDUSTRIAL POWER WASHERS • FLOW & DIP COATERS • SPRAY BOOTHS
AIR COMPRESSORS • SPRAY EQUIPMENT • HOSE & CONNECTIONS • MIST-COOLANT UNITS

Field Report . . .

annual payroll of $18 million. Facility will produce no steel when it opens but will fabricate and finish ingots received from Great Lakes Steel Div in Detroit. Products will be tin plate, galvanized coils and sheets, and hot and cold sheet items.

Eutectic Expands in Switzerland

Eutectic Welding Alloys Corp, headquartered in New York, is building a new foundry and expanded metallurgical division next to its European Welding Center in St Sulpice, Switzerland. Facilities will be capable of producing welding rods and electrodes from virgin metals to finished products in any metal.

Hoffman Laboratories Div . . .

. . . of Hoffman Electronics Corp, Los Angeles, has a $5.9 million Navy order for production of a passive countermeasures system for underwater and surface craft. Contract, scheduled to run for a three-year period, is for equipment originally developed by Hoffman under a previous R&D contract. Hoffman Labs' current backlog is $75.5 million, up 300% from this time last year.

German Cold Forming Bolt Maker To Be Handled by US Agency

New US and Canada sales and service engineering organization, Boltmaster Co, has been formed in Cleveland to import the bolt forming machines of Peltzer & Ehler which have been marketed abroad since 1888. Machines being imported

"How would you like to have this machine fixed so it'll stay fixed?"

Automotive Power Steering Manufacturer Specifies

Cold drawing Ostuco tubing through precision ring die on cold draw bench at Shelby mill. Mandrel controls and sizes I.D.

"Automotive components are our business. We have produced literally millions. And we're still learning every day.

"One of the lessons we learned early in the game is that you can't beat Ostuco tubing for surface finish. It cuts our machining costs, keeps us on top competitively.

"There are other reasons, too, why Ostuco tubing tops our preferred list. We like its consistently close tolerances and unvarying quality, shipment after shipment. You might say we like its *product integrity* . . . "

To learn more about what Ostuco tubing can do for *your* production, contact your Ohio Seamless representative, listed in the Yellow Pages, or the mill at *Shelby, Ohio — Birthplace of the Seamless Steel Tube Industry in America.*

AA-9481

OSTUCO TUBING

OHIO SEAMLESS TUBE DIVISION

of Copperweld Steel Company · SHELBY, OHIO

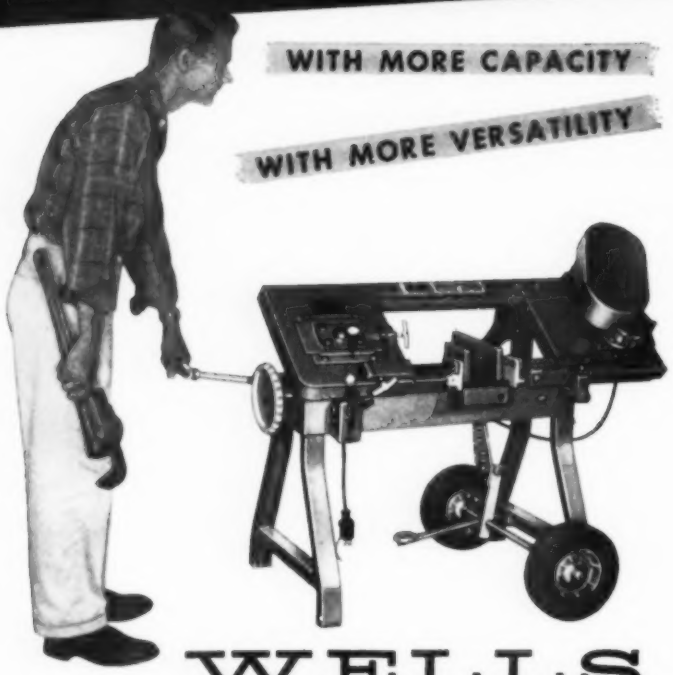
Seamless and Electric Resistance Welded Steel Tubing • Fabricating and Forging

SALES OFFICES: Birmingham, Charlotte, Chicago (Oak Park), Cleveland, Dayton, Denver, Detroit (Huntington Woods), Houston, Los Angeles (Lynwood), Miami, Moline, New Orleans (Chalmette), New York, North Kansas City, Philadelphia (Wynnewood), Pittsburgh, Rochester, St. Louis, St. Paul, Salt Lake City, Seattle, Tulsa, Wichita CANADA: Railway & Power Engr. Corp., Ltd. EXPORT: Copperweld Steel International Company, 225 Broadway, New York 7, New York

A NEW, COMPLETELY MOBILE CONVERTIBLE BAND SAW

WITH MORE CAPACITY

WITH MORE VERSATILITY



WELLS Model 58-B

Here's a compact, convertible band saw designed for shop or "job-site" work . . . the Wells Model 58-B. It provides the capacity you've been looking for . . . at a modest price. Equipped with optional wheel handle unit, the Model 58-B becomes completely mobile . . . easily rolls from job to job. Use the 58-B as a horizontal cut-off machine (capacity: 6" x 10") or swing the head to upright position, install work table and it's a utility vertical band saw. For complete details on this double duty—double value band saw, see your Wells Distributor or write for Bulletin 262.

SPECIFICATIONS

Capacity:		**Floor Space**	19" x 47"
Rectangular	6" x 10"	**Height (Frame Vertical)**	52"
Round	6" Diameter	**Height (Frame Horizontal)**	37"
45° Angle	5" x 5"	**Vertical Capacity:**	
Speeds, f.p.m.	76—141—268	Work Table	7⅛" x 10"
Blade Size	½" x .025" x 93"	Throat Height	9½"
Motor	½ H.P.	Throat Depth	7¾"
Width of Bed	8½"	**Net Weight (Approx.)**	220 lbs.
Floor to top of Bed	22¼"		

The Pioneers of Horizontal

Wells

METAL CUTTING BAND SAWS

WELLS MANUFACTURING CORPORATION
505 ROOSEVELT ROAD, THREE RIVERS, MICHIGAN

include automatic hot nut presses, screw slotting machines, single and double blow cold headers, complete boltmakers, progressive headers, and related machinery.

Ships Wrecked in Alabama

Shipwrecking, Inc, is a new Mobile firm that will hire about 200 workers to scrap four freighters a month. Salvage will be sold in both domestic and foreign markets. New company will bid on surplus government ships as well as private vessels.

Radar Order to Texas Instruments

Texas Instruments, Dallas, has a $9.3 million Navy order for advanced airborne surface search radar systems. The radar, developed by TI's Apparatus Division, will be installed in large patrol aircraft for long-range detection of surfaced subs. Delivery of the first system under the new contract is scheduled for fall.

Buhr Expands Services

Buhr Machine Tool Co has set up a separate field service department to help customers solve service problems in their plants. Company has also established a consulting service on correct preventive maintenance procedures for Buhr Economatics. Headquarters for the new department will be located in the Ann Arbor, Mich, plant.

Altamil Buys Twigg

Altamil Corp of El Segundo, metal-working subcontractor for the aircraft and missile industries, has acquired the assets and going business of Twigg Industries Division of Pryor Manufacturing Co. Twigg, with plants at Brazil and Martinsville, Ind, produces structural assemblies for aircraft and missiles; Altamil is active in machining, metal sculpturing, contouring, forming, chemical milling, fabrication, and assembly.

AIL Producing Radar Device

Airborne Instruments Laboratory Division of Cutler-Hammer, Inc, has an $8 million AF contract for 20 pieces of equipment designed to eliminate unwanted interference on radar screens used in the SAGE air defense system. This is reported to be an initial order of a series of procurement programs to equip additional SAGE radars.

Convair Offers Optical Service

The optical and infrared facilities of Convair San Diego's electronics subdepartment of engineering are now equipped to turn out precision optical work for other departments at Convair SD, other Convair divisions, or outside companies. The shop is equipped with the only precision infrared optical bench in the country for checking out errors in infrared or visible optical systems.

Pullman-Standard Orders

Louisville & Nashville RR has ordered $1.5 million worth of parts for freight cars from Pullman-Standard's Bessemer, Ala, plant. And Seaboard Air Line RR wants half-a-million plus worth of spare parts to convert 200 hopper cars. The spare parts plant of the Bessemer facility was completed recently at a cost of over $1 million.

Insulation Information Center

Center, for consultation by industry on insulation characteristics, application techniques, and specifications, has been set up by the newly formed National Insulation Manufacturers Association in New York. NIMA member companies make insulations for the full temperature range of —460 to 1900 F. Center will provide information on all insulating materials.

Lithium Moving East

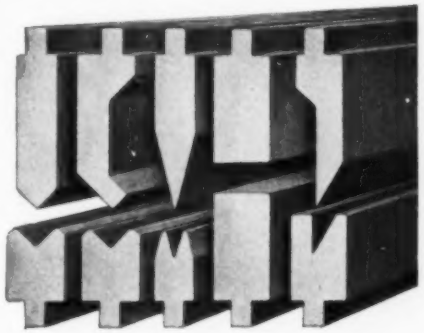
Lithium Corp of America will move the Minneapolis general offices to the New York City area, and its St Louis Park, Minn, manufacturing facilities, R&D labs, and pilot plant to Bessemer City, NC, where the company operates a $7 million lithi-

"Gee, fellows, is it time to quit, already?"

ALABAMA
Birmingham
Hinkle Supply Co., Inc.—FAirfax 2-4541
CALIFORNIA
Los Angeles
Meyer Sheet Metal Mchry. Co.—VAn Dyke 1477
San Francisco
Harron, Rickard & McCone Co.—ATwater 2-2202
GEORGIA
Atlanta
Allison Mchry. Co.—JAckson 4-1741
INDIANA
Indianapolis
E. L. Humston Co., Inc.—WAlnut 5-9691
IOWA
Bonaparte
Corry's Machine & Tool Co.—Phone: 112
KANSAS
Wichita
Elffeldt Mchry. & Supply Co.—AMherst 7-9773
MASSACHUSETTS
Cambridge
Austin-Hastings Co., Inc.—Kirkland 7-4480
MICHIGAN
Detroit
J. Lee Hackett Co.—TRinity 2-6442
MINNESOTA
Minneapolis
Minnesota Steel & Mchry. Co.—FEderal 3-6273
MISSOURI
Kansas City
Elffeldt Mchry. & Supply Co.—VIctor 2-5494
NEW YORK
New York
Federal Machinery Corp.—CAnal 6-3022
Triplex Machine Tool Corp.—EMpire 1-1700
H. Weiss & Co.—CAnal 6-4256
NORTH CAROLINA
Greensboro
Armentrout Mchry. Co.—Phone: 4-8218
OHIO
Columbus
Vorys Brothers, Inc.—AXminster 4-4701
OKLAHOMA
Oklahoma City
Hart Industrial Supply Co.—REgent 9-2541
Tulsa
Hart Industrial Supply Co.—LUther 3-2175
OREGON
Portland
Pacific Metal Co.—CApitol 7-0693
PENNSYLVANIA
Philadelphia
Delaware Valley Mchry., Inc.—OLdfield 9-4600
Milton Equipment Co.—WAlnut 2-1734
Pittsburgh
Wm. K. Stamets Co.—ATlantic 1-8091
TEXAS
Dallas
Briggs-Weaver Mchry. Co.—LAkeside 8-0311
Fort Worth
Briggs-Weaver Mchry. Co.—EDison 6-5621
Houston
Mehl Machinery, Inc.—FAirfax 3-1313
WASHINGTON
Seattle
Pacific Metal Co.—MAin 6925
WISCONSIN
Milwaukee
Production Equip. Inc.—GReenfield 6-6075

CANADA
A. R. Williams Machinery Co., Ltd.
ALBERTA
Calgary—Phone: 5-4425
Edmonton—Phone: 24341
BRITISH COLUMBIA
Vancouver—TAtlow 9411
Victoria—Phone: 4-7623
MANITOBA
Winnipeg—SPruce 4-4458
NOVA SCOTIA
Halifax—Phone: 5-4389
ONTARIO
Hamilton—JAckson 9-5388
Ottawa—CEntral 6-3661
Toronto—EMpire 4-2381
Windsor—CLearwater 4-4762
QUEBEC
Montreal—RIverside 8-9381
8925

Off-the-shelf
DELIVERY



CHICAGO®
Induction Hardened*
PRESS BRAKE DIES

This organization of local distributors offers immediate delivery on many CHICAGO *induction hardened* press brake dies. These stock dies are economical, and the quick delivery saves time in tooling. They are available in any length from 4 to 12 feet in increments of 2 feet.

Stock dies are used for a surprisingly large variety of bending operations. And, with CHICAGO *induction hardened* dies you get bonus performance and increased die life at no extra cost. Remember, these dies can be used in any make or size of standard press brake.

On your needs for press brake dies, call your nearest distributor listed here. With Bulletin D-457 you can order by number. Ask for a copy.

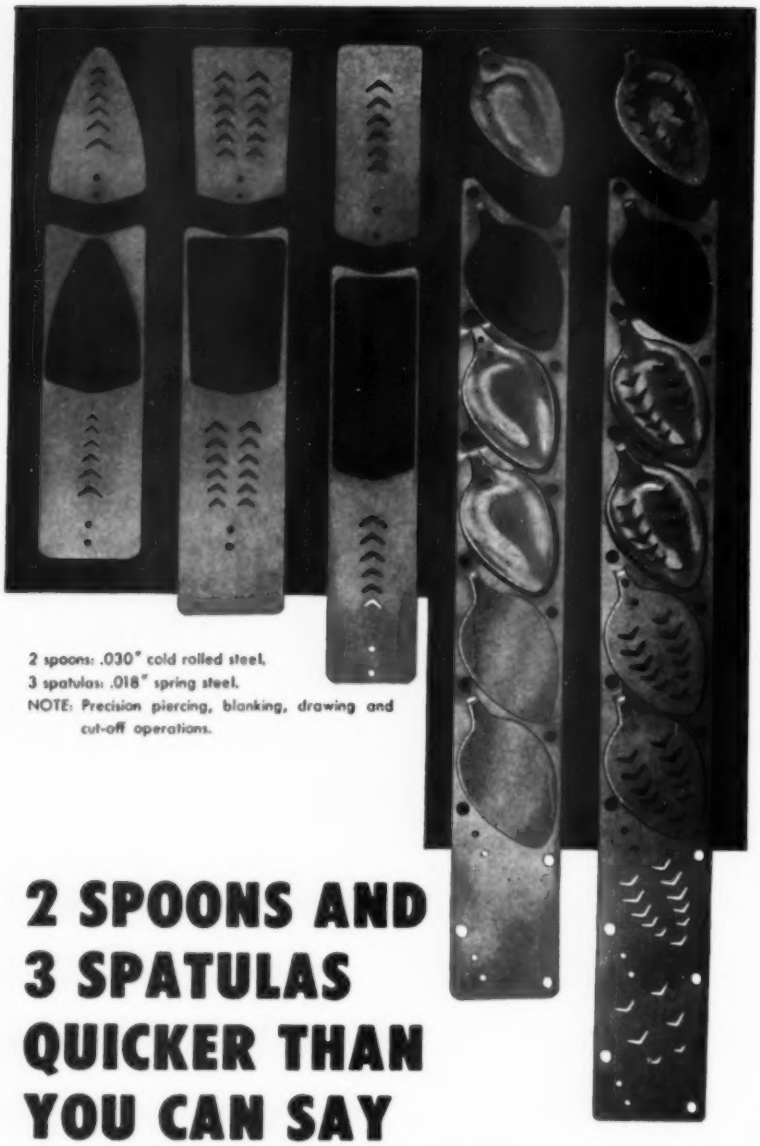
*Induction hardening is a special, high-frequency process used to harden the wear surfaces of CHICAGO dies. Field reports on CHICAGO *induction hardened* dies show up to ten times longer life than conventional press brake dies.

CHICAGO DREIS & KRUMP

Press Brakes, Press Brake Dies
Straight-Side-Type Presses

Hand and Power Bending Brakes
Special Metal-Forming Machines

DREIS & KRUMP
MANUFACTURING CO.
7434 South Loomis Boulevard
Chicago 36, Illinois



2 spoons: .030" cold rolled steel.
3 spatulas: .018" spring steel.
NOTE: Precision piercing, blanking, drawing and cut-off operations.

2 SPOONS AND 3 SPATULAS QUICKER THAN YOU CAN SAY "FLAPJACK!"

Precision mass production of mixing spoons and spatulas—modern designs for modern homemakers—products of B. Jahn "Production Proved" Progressive Dies.

One of America's foremost kitchen tool manufacturers entrusted these five dies to B. Jahn because "nothing is too good for their customers." The result, dependable trouble-free tooling, a superior product, exceptional production speed and economy.

If your product is mass produced...

If "nothing is too good for your customers"...

If dependable production and competitive economy is desirable...

B. Jahn is your source for production speed, economy and tooling ingenuity.

B. Jahn

Send for colorful "Case History" Brochure

THE B. JAHN MANUFACTURING COMPANY, NEW BRITAIN, CONNECTICUT

Field Report...

um chemical plant. Joining of Minnesota operations with those in NC will provide the company with integrated manufacturing and research facilities, in addition to reducing freight and raw material costs.

Permanent Machine & Tool Co...

... a new Alabama concern making special dies for the non-ferrous metals industry, and an affiliate of Permanent Mold Die Co, Detroit, has started construction of a building in Florence, Ala. Permanent Mold Die has been furnishing dies for Ford Motor Co's Muscle Shoals operation since 1957.

American Machine & Metals...

... East Moline, Ill, has acquired the assets of Automatic Devices Co, Western Springs, Ill, designer and manufacturer of heating, cooling, and air conditioning controls. It will be operated as the Automatic Devices Division.

Leece-Neville ac Motors...

... will be made at production facilities located in Gainesville, Ga. The Cleveland company recently purchased this line from the O A Sutton Co, Wichita, Kans. Limited production is scheduled to be moving from the Gainesville Div by early fall.

GMC Truck & Coach...

... is offering an all-aluminum sports cab to fit on its wideside pick-up truck; it can be installed in a matter of minutes with six bolts. Body is fully insulated with half-inch fiberglass and is reported to retail at about $500.

"Well, quite frankly, we're looking for someone between thirty-five and forty with thirty years' experience."

New! AIR CONTROL UNITS

Automatically

- ★ Filter pressurized air to provide a clean, dry air supply
- ★ Compensate for fluctuations in air pressure delivered by the air supply system
- ★ Compensate for variations in cfm requirements of pneumatic equipment
- ★ Adjust amount of misted lubricant to meet changing cycle rates or surge demands

The new Bellows Lubri-Air® Control Unit

T.M. Registered
Pat. Pending

● This new Lubri-Air Control Unit, made by The Bellows Co., and sold and serviced by Bellows and Valvair Corporation Field Engineers, is a major break through to the problem of supplying clean, dry, pressure-regulated and properly lubricated air to pneumatic equipment.

The Bellows Lubri-Air Control Unit, once set to match the needs of the equipment it serves, automatically removes dirt and moisture from the air stream, maintains a constant down stream pressure regardless of fluctuations in supply pressure or in cfm requirements, and feeds a correct amount of misted oil to the air stream regardless of variations in the air flow rate.

Bellows Lubri-Air Control Units assure continuous top working efficiency as well as maximum long life with minimum maintenance from air-powered equipment.

Available for immediate delivery in the ¼", ⅜" and ½" sizes. ¾" and 1" sizes shortly.

See your Bellows-Valvair Field Engineer or write direct to Dept. AM-959, The Bellows Co., Akron 9, Ohio, for descriptive Bulletin LA-15.

14978

The Bellows Co.
DIVISION OF INTERNATIONAL BASIC ECONOMY CORPORATION (IBEC)
AKRON 9, OHIO

OTHER INDUSTRIAL DIVISIONS OF IBEC: Sinclair-Collins Valve Co., Valvair, Akron, Ohio • V. D. Anderson Co., Cleveland, Ohio

INCREASED PRODUCTION

IMPROVED FINISH

HIGHER MACHINING SPEEDS

LONGER TOOL LIFE

YOU'LL ENJOY ALL *These* SAVINGS WITH

WYCKOFF LEADED STEELS

AVAILABLE IN A.I.S.I. ANALYSES
CARBON AND ALLOY STEELS

SPECIALISTS IN COLD FINISHED STEELS EXCLUSIVELY

WYCKOFF STEEL COMPANY

GENERAL OFFICES:
Gateway Center, Pittsburgh 30, Pa.

Branch Offices in Principal Cities

Works: Ambridge, Pa., Chicago, Ill., Newark, N.J., Putnam, Conn.

OUR CONSTANT RESEARCH PROGRAM IS YOUR BEST GUARANTEE OF QUALITY CONTROL

WYCKOFF STEEL PRODUCTS • Carbon, Alloy and Leaded Steels • Turned and Polished Shafting • Turned and Ground Shafting • Large Squares • Wide Flats up to 12½" x 2½" and 14" x 1½" • All types of Furnace Treated Steels including Carbon Corrected Steels

Free Literature

To order any of these bulletins, circle corresponding number inside back cover.

MACHINES AND ATTACHMENTS

1 CYLINDRICAL GRINDER FEED SYSTEM—*Landis Tool Co, Waynesboro, Penna.* 4-page bulletin MF-59 illustrates and describes the Microfeed, a new wheel feed that is an ultra-fine feed to final size that cancels grinding feed variables which affect conventional precision cylindrical grinders. Typical Microfeed grinding cycle is pictured; cost saving advantages listed.

2 SPINDLES—*Bryant Chucking Grinder Co, Springfield, Vt.* 14-page catalog presents data on high-frequency and motorized spindles, and built-to-order induction motors. Includes detailed, illustrated descriptions, application information, product diagrams, and specifications charts.

3 "TITANIUM MACHINING TECHNIQUES"—*Titanium Metals Corp of America, 233 Broadway, New York 7, NY.* 32-page manual outlines do's and don'ts for successful turning, milling, drilling, tapping, grinding, and sawing of commercially pure and alloy grade titanium. Tabular data is arranged so that recommendations can serve as workable guides to establishment of economical procedures under conditions that vary from shop to shop.

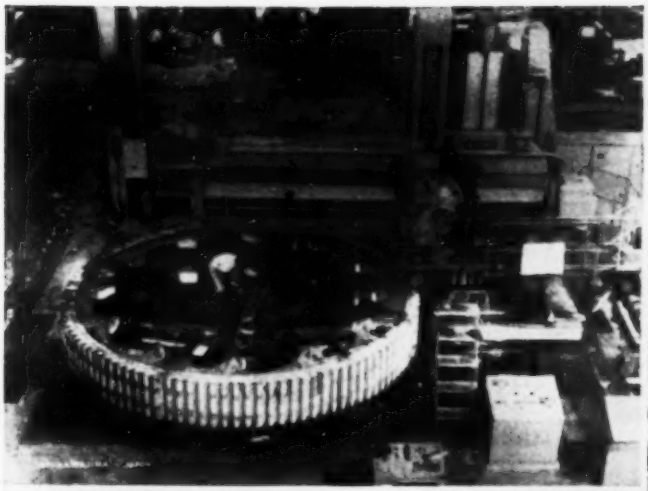
TOOLS AND ACCESSORIES

4 MECHANICAL TOOLHOLDERS — *Firth Sterling Inc, 3113 Forbes Ave, Pittsburgh 30, Penna.* 18-page catalog MTI-5 contains detailed information on complete line including positive rake and heavy-duty toolholders; diamond and round shaped insert holders; Firthite Thriftool and Firthite throw-away inserts; diamond shaped inserts; and utility ground positive rake and triangle inserts.

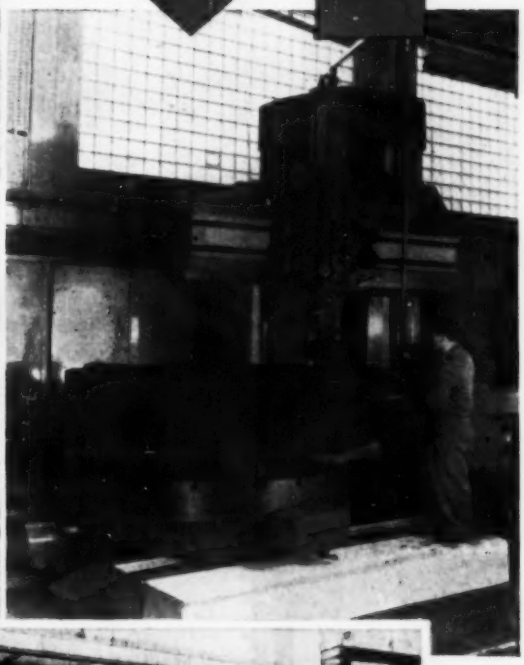
5 DIAL INDICATORS—*Federal Products Corp, 1144 Eddy St, Providence 1, RI.* 4-page brochure describes the Miracle Movement indicator that incorporates high wear and shock resistance. Models which are available with the new movement are illustrated; ordering information and price list included.

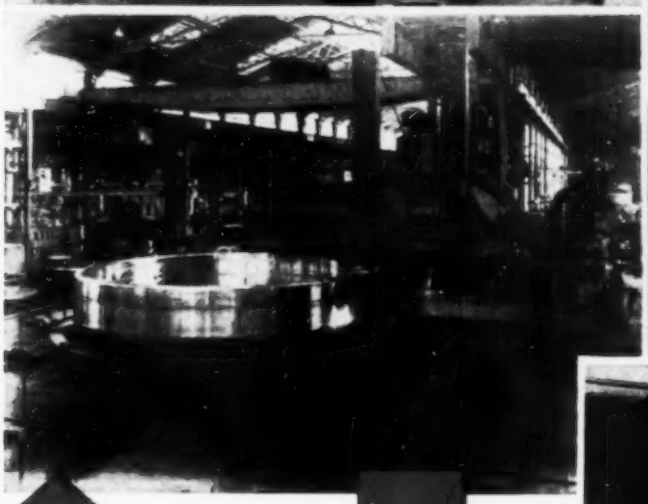
6 ELECTRONIC INSTRUMENTS — *Wayne Kerr Corp, PO Box 801, Philadelphia 5, Penna.* 6-page short-form catalog describes and pictures 20 instruments. Includes product and basic specification information on line of transformer ratio-arm bridges, oscillators, transistors adaptors, milliwattmeters, and wattmeters.

"You didn't hear a word I said!"

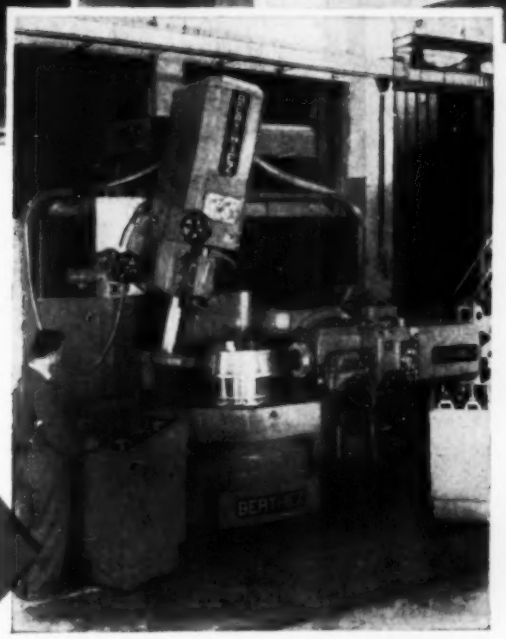


Vertical Boring and Turning Mill
type BML 180





Vertical Boring and Turning Mill
type 9375



Vertical Chucking Grinder type 1009

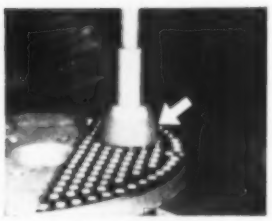
BERTHIEZ

11 RUE MONTALIVET PARIS 8e TÉL : ANJ. 47-60

Here's how

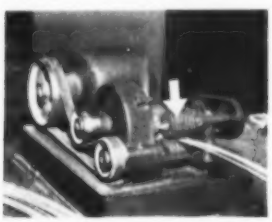
JOB-PROVED TY® BRUSHES

are cutting metal-finishing costs across the board



Application: deburring

Application: Surface finishing



Application: wire insulation stripping

In use today on a wide range of applications—Osborn TY® Tool Brushes are *engineered to cut finishing costs.* New TY Brushes are designed for jobs *beyond the reach* of standard wire power brushes.

Where rotary files, abrasive stones or belts, tumbling and shot blasting equipment have been used—TY Brushing Methods now do many of these jobs better and faster . . . at significantly less cost.

Do you know which operations in *your plant* can be done at high production rates . . . with better quality control . . . at less cost with new TY Brushes? An **O**sborn **B**rushing **A**nalysis—made in your plant now at no cost—is the first step. Write for full details.

Exclusive TY Brush advantages performance proved on-the-job:

- Maximum of work efficiency with minimum of pressure.
- Greatly increased brushing action strength.
- Positive control over area of brush contact.
- Complete uniformity of finish.
- Exceptionally long brushing tool life.

Write For Free TY® Brush Booklet . . . complete, illustrated application and specification data for production men. *The Osborn Manufacturing Company, Dept. C-89, Cleveland 14, Ohio.*

Osborn Brushes®

POWER, PAINT AND MAINTENANCE BRUSHES
METAL FINISHING MACHINES . . . AND FINISHING METHODS
FOUNDRY PRODUCTION MACHINERY

Free Literature

To order any of these bulletins, circle corresponding number inside back cover.

Provides data on new vibration meter, electronic micrometer, precision attenuator calibrator, and the wide band attenuator.

● CONTROLLED-AIR-POWER WORK UNITS—*Bellows Co, Akron 9, Ohio.* 16-page brochure illustrates (with installation photos) examples of ways in which Bellows air motors and other work units are used in a variety of industries to increase productivity per machine and man hour, reduce scrap, and prolong tool life. Request direct on company letterhead.

7 BORING BAR ELEMENTS — *Giddings & Lewis Machine Tool Co, Davis Division, Fond du Lac, Wis.* Catalog D-520 presents new system of listing and pricing individual elements of a boring bar to enable users to secure custom-arranged bars at standard prices. Describes both general purpose and production bars for either line or stub boring operations. Slots for block tooling, straight-through or angular flycutter tooling, and Davis Super-Mike flycutter tooling assemblies are priced individually; different size keyways are priced per inch of length.

8 COUNTERSINKS — *Madison-Relco Tool Co, PO Box 1137, Providence, RI.* 4-page bulletin illustrates and describes a new type of adjustable unit, explains how bearing principle insures chatterless, safe operation regardless of feed or alignment. Sizes and dimensions of 15 countersinks covering 1/64 to 2 capacity in 60°, 82°, and 90° are listed in tabular form.

9 UNIVERSAL DIE BASE — *Wales-Strippit, Inc, 200 S Buell Rd, Akron, NY.* Catalog CJDB describes new type of die base for Strippit Type CJ hole punching units which reportedly cuts replacement cost of round and shaped dies by approx 50%. Dimensions and specifications included.

10 ELECTRONIC INDICATING RECORDERS — *Thermo Electric Co, Saddle Brook, NJ.* 4-page bulletin 66 covers recorders and indicating recorder-controllers for any measurable voltage or resistance change. Describes and gives applications for both units; provides information on sensitivity, accuracy, control and alarm function, installation, operation, and maintenance.

11 VIBRATION INTERFEROMETER —*Gaertner Scientific Corp, 1201 Wrightwood Ave, Chicago 14, Ill.* Bulletin 204-59 provides information on instrument specially designed for extremely precise checking and calibration of accelerometers. Includes applications, product features, specifications.

12 BALANCERS—*Bear Mfg Co, Industrial Division, Rock Island, Ill.* Catalog and four data sheets describe and illustrate line of Bekomatic production line balancers. Covers three horizontal models ranging in workpiece capacities from 1 oz to 400 lbs and from 10 to 30-in. diameters. Two vertical models handle work capacities from 1 lb to 75 lbs and up to 20 in. in dia.

13 CUP WHEELS — *Carborundum Co, Niagara Falls, NY.* 4-page illustrated folder contains information on "Built-in Guard" safety cup wheels for portable grinding in welding shops. Includes construction and design features, specifications, recommendations, and ordering information.

HEAT TREATING AND WELDING

14 WELDING EQUIPMENT — *Hobart Brothers Co, Troy, Ohio.* 24-page catalog EW-209 describes and illustrates

all Hobart arc welding machines with specifications and ordering information. Covers gasoline and diesel engine driven welders, engine driven welder-power combination units, electric motor driven arc welders, rectifier and transformer type welders, combination transformer-rectifier type units, ac and dc inert-gas-shielded arc welders, and a complete line of automatic and semi-automatic welding equipment.

15 ELECTRONIC TRACER—*Linde Co. Division of Union Carbide Corp, 420 Lexington Ave, New York 17, NY.* 4-page illustrated booklet, form 1287, describes the Photocell Tracer. Pencil line sketches of intricate shapes and forms can be used to guide oxygen shape-cuttings machines equipped with the tracer. Built-in automatic kerf compensator makes it possible to reproduce one or thousands of complicated metal parts with extreme accuracy from exact size drawings.

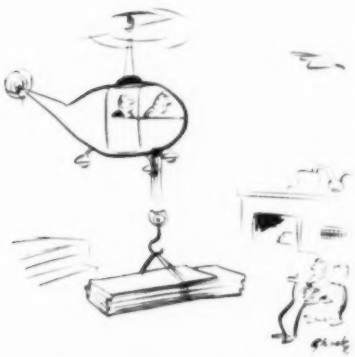
16 STUD WELDING — *Nelson Stud Welding, Division of Gregory Industries, Inc, Lorain, Ohio.* 12-page booklet illustrates a dozen widely varied applications which have enabled manufacturers to reduce fastening costs from 30 to 60%. Includes a cost reduction work sheet to compute savings obtainable on specific fastening operations.

17 FURNACE EQUIPMENT—*Sunbeam Equipment Corp, 180 Mercer St, Meadville, Penna.* Five bulletins available describe: atmosphere generators (bulletin SEC-G1); bell-type furnaces (bulletin SEC-2); box-type electric furnaces (bulletin SEC-3); box-type fuel-fired furnaces (bulletin SEC-4); pot-type furnaces (bulletin SEC-5).

18 PROGRAMMED TIME-AMPERAGE CONTROL FOR CRITICAL WELDING—*Harnischfeger Corp, Welding Equipment Division, 4400 W National Ave, Milwaukee 46, Wis.* 4-page illustrated bulletin W-155 describes five units for the sequence timing of welds, including motorized rheostat controls and punched-tape programming.

19 ELECTRODES — *National Cylinder Gas Division of Chemetron Corp, 840 N Michigan Ave, Chicago 11, Ill.* Data sheets on complete line of Sureweld electrodes include information on welding characteristics, current, suggested procedures, specifications to which the electrode type conforms, physical properties and chemical analysis of deposited metal, recommended current range-stock sizes, and typical applications for each electrode.

20 CRYOGENERATORS FOR GAS LIQUEFACTION SYSTEMS—*North American Philips Co, Cryogenics Division, 100 Stevens Ave, Mount Vernon, NY.* 6-page folder provides engineering information on four models: 3000 BTU per hr,



"We bought it to save money—don't ask me to explain how—"

PERTINENT QUESTION:

WHEN do you need the Profilometer®?

FACTUAL ANSWER:

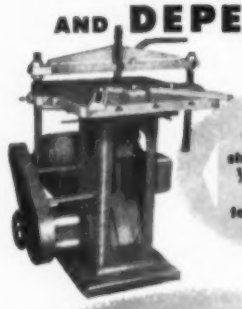
Whenever you must precisely *know* the roughness of *any* production surface — quickly, dependably, in microinches (arithmetical or rms).

FREE BULLETIN LT14 gives details — describes cost-saving applications. May we send you a copy?

MICROMETRICAL MMC MANUFACTURING COMPANY
345 S MAIN ST. ANN ARBOR 1 MICHIGAN

Manufacturer of the PROFILOMETER®, PROFICORDER®, MICROCORDER, WAVOMETER®, ANDEROMETER®, VAROMETER, CHART VIEWER • Exclusive American Sales Agent for CENSOR Dimensional Gaging and Sorting Equipment

FOR **EFFICIENCY**
AND **DEPENDABILITY**
USE



Northfield KEYSEATERS
This keyseater is designed to cut straight or tapered keyways from ⅛" to 1" wide. Work of any shape and diameter can be clamped to the table and cut, grooved, or slotted.

Northfield BAND SAWS
Speed, precision, dependability, value, all are painstakingly built into the Northfield 36" Band Saw. Speeds can be altered for different metals, plastics, fabrics, woods, etc.

Northfield CIRCULAR SAWS
A heavy duty, accurately constructed machine with every feature for circular sawing in any shop. Adaptable for cutting light metals, plastics, woods, etc.

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CIRCLE 287 READER SERVICE CARD

One of these Wilson "Rockwell" instruments will do your hardness testing job

No matter what your hardness testing requirements are, there's a Wilson "Rockwell" tester to do the job. Choose from this complete selection of hardness testing equipment:

"Rockwell" Hardness Tester—for most hardness testing functions.

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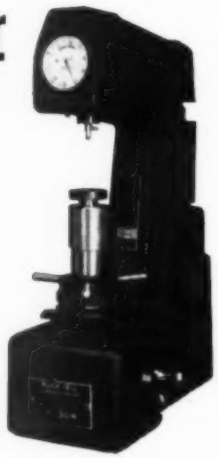
Diamond "Brale" Penetrators—Flawless diamonds, individually calibrated, and highest quality construction assure perfect testing every time.



Write for **Bulletin RT-58**

WILSON "ROCKWELL" HARDNESS TESTERS

Wilson Mechanical Instrument Division
American Chain & Cable Company, Inc.
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Free Literature

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12,000 BTU/hr, 30,000 BTU/hr, and 170,000 BTU/hr—all at −320 F. Curves are presented for each model showing relationship between refrigeration capacity, condensing temperature, and brake hp. Drawings give physical dimensions of units. Operating principle discussed, applications described.

21 CO_2 WELDING PROCESSES—*A O Smith Corp, Welding Products Division, Milwaukee, Wis.* 16-page brochure MW-253 contains information on CO_2-shielded welding processes: C-OMANUAL, a semi-automatic hand-gun; C-OMATIC, fully automatic; and C-OMANUAL BUTTON WELDER, a semi-automatic hand-gun process. Illustrated charts outline typical applications from lap joints and fillets to butt and lap welds. Charts detail wire diameters, amperages, voltages, travel speeds, weld positions, and deposition rates for each type of weld. Typical physical and mechanical properties that result are discussed.

PLANT SERVICE EQUIPMENT

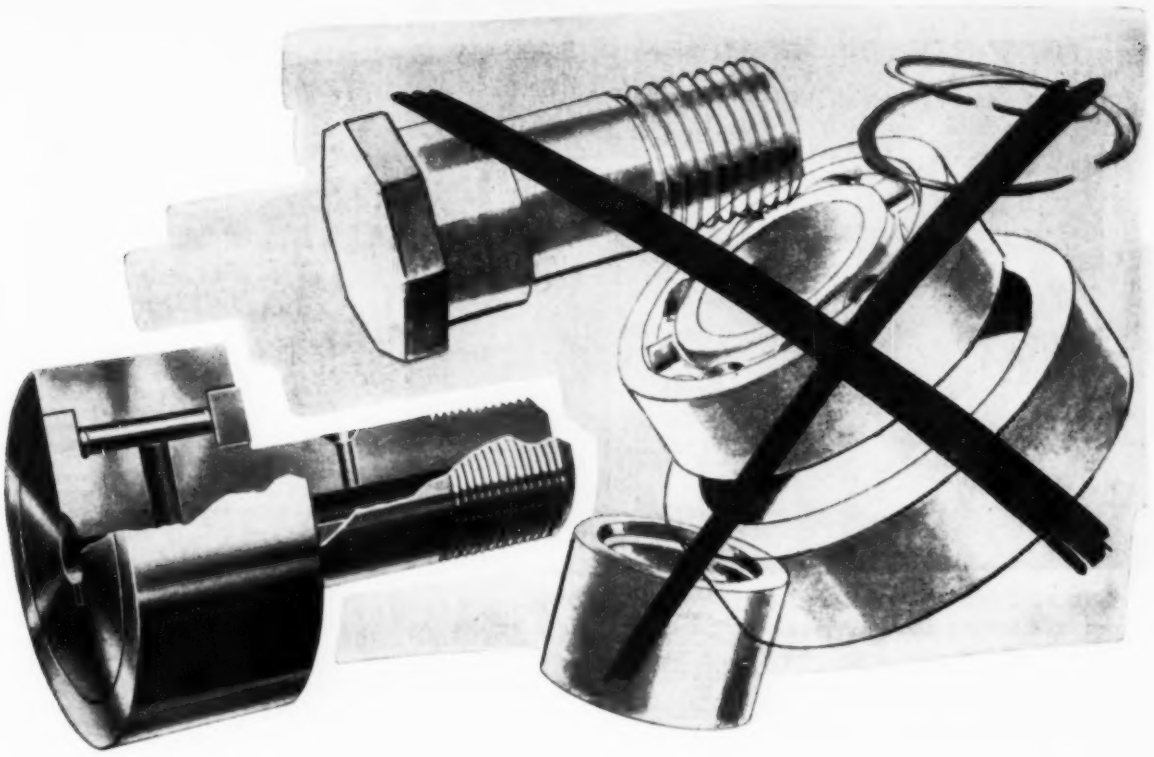
22 PRE-BILT SECTIONAL BELT CONVEYORS—*Link-Belt Co, Prudential Plaza, Chicago 1, Ill.* 40-page handbook 2779 covers use and selection of standardized conveyors, pre-engineered and shop-assembled from matched components. They are available in four belt widths of 18, 24, 30, and 36 in. Includes list of 22 components and accessories, detailed engineering and selection data, illustrated installation applications.

23 METAL CLEANING HANDBOOK—*Magnus Chemical Co, Equipment Division, Dept AM, Garwood, NJ.* 32-page handbook presents over a hundred types of equipment and techniques for the cleaning and preparation of metal surfaces. Covers basic factors in metal cleaning and specific methods to meet a variety of problems, including degreasing, decarbonizing, washing, bonderizing, stripping, drying, blackening, phosphatizing, rust proofing, pickling, and coating.

24 FORK LIFT TRUCK EQUIPMENT—*Allis-Chalmers Manufacturing Co, Milwaukee, Wis.* 8-page catalog BU-497 illustrates and describes accessories and optional equipment for the A-C line of lift trucks. Covers power-steering, water muffler, fork extensions, tires, lubrication system, overhead safety guard, hydraulic accumulator, fire extinguishers, crane arms, and ram.

25 WATER KNIVES—*Chain Belt Co, Milwaukee 1, Wis.* 12-page bulletin 5983 covers Rex water knives (formerly marketed as flat spray nozzles) for any type of washing, cleaning, descaling, and

"There's a laugh a minute around this place. My salary is one of them."



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eliminate the cost of producing and assembling improvised cam follower, track and guide roller units

THESE CAMROL ADVANTAGES SOLVE COST, DESIGN, PRODUCTION AND PERFORMANCE PROBLEMS:

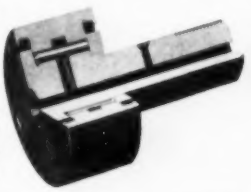
• AVAILABILITY • INTEGRAL UNIT CONSTRUCTION • HIGH LOAD CAPACITY • SMALL RADIAL SPACE REQUIREMENTS • HIGH SHOCK RESISTANCE • PRECISION ACCURACY • SIMPLIFIED LUBRICATION

You can simplify design and cut cost with CAMROL, precision cam followers. Procurement, production and assembly of components for improvised units are eliminated when you specify CAMROL bearings that are available from stock.

McGill developed the original roller bearing cam follower and perfected the CAMROL design through 25 years of application experience. Its full type construction provides exceptionally high capacity in an integral unit of a flanged, specially heat treated stud and heavy shock resistant outer race. Grease lubrication is simplified. Plain bearings require constant oil lubrication and bolt mounted ball bearings races crack under equivalent loads.

Precision construction, including concentricity of stud to outer race OD, provides accurate alignment of machine members. Ease of interchangeability and dependable operation in any cam action, track, guide or support roller application is assured. Use the CYR series in the same roller diameters for shaft mounting.

PRE-LUBRICATED SEALED CAMROL BEARINGS



These bearings combine the advantages of CF and CYR series bearings plus effective sealing against dirt, dust and grit. Ideal in applications where lubrication is a problem. Black ferrous oxide finish resists corrosion in contaminated areas.

CAMROL bearings are available in standard roller diameters from ½" to 4". Capacities to 20480 lbs. at 100 RPM.

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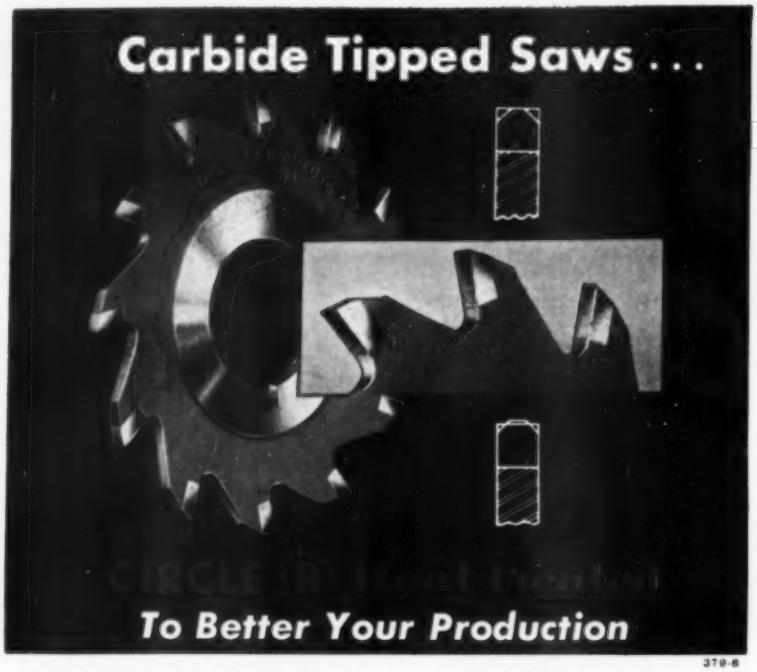
precision needle roller bearings

McGILL MANUFACTURING COMPANY, INC., BEARING DIV., 300 N. LAFAYETTE ST., VALPARAISO, INDIANA



370-B

CIRCLE R Carbide and Carbide Tipped Saws increase production manifold on tough jobs — and keep up the pace because *they retain their tips,* due to superior tipping-in. And exclusive Circle R Heat Treating perfects them for your purposes. Ask your Circle R Specialist.

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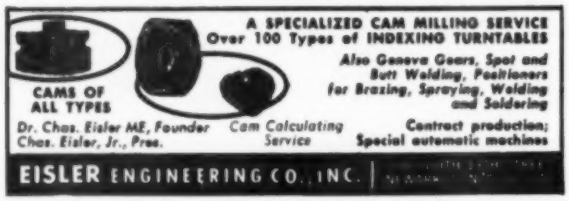
CIRCLE 273 READER SERVICE CARD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Heavy duty steel letter and figure stamps carried in stock in wide range of sizes. Cost more but even stamps semi-hard steel. Preferred by tool makers. Write for Bulletin!
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cooling operations. Contains selection data, specifications, application information.

26 AUTOMATIC WASTE DISPOSAL SYSTEM — *Wandel Machine Co, Pomeroy, Penna.* 12-page bulletin describes the Somat machine that chews waste, renders it odorless without use of chemicals, reduces it into finely ground, compacted pulp, and discharges it into haul-away containers for disposal. Applications illustrated.

27 ELECTRIC POWERED FORK LIFT TRUCK—*Lewis-Shepard Products, Inc, 125 Walnut St, Watertown 72, Mass.* 6-page illustrated circular 32B contains information on heavy-duty Sitdrive Model C Spacemaster with Inchomatic drive control system that permits exact inching and load spotting. Unit is available in 30 different models and capacities to 4000 lbs. Specifications and operating characteristics included.

PARTS AND MATERIALS

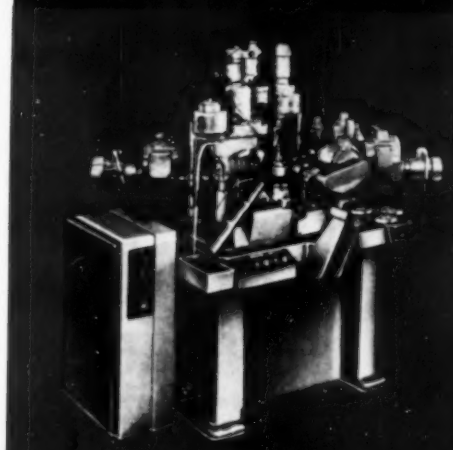
28 SPRING CLUTCHES — *Curtiss-Wright Corp, Marquette Division, 1145 Galewood Drive, Cleveland, Ohio.* 28-page catalog describes and pictures five standard lines in bore sizes from ¼ to 1 in. and torque capacity up to 1250 lb-in. They are designed for applications utilizing drive up to 5 hp. Five basic series include A, over-running and back-stopping; B, indexing; C, on-off; D, on-off indexing, and E, safety lock control. Specifications and application data included.

29 HIGH-STRENGTH, HIGH-TEMP STEELS—*Universal - Cyclops Steel Corp, Station St, Bridgeville, Penna.* 29-page bulletin covers Unimach I and Unimach II for critical structural applications in airborne vehicles. Technical data includes information on heat treatment, physical and mechanical properties. Graphs illustrate tensile and yield strengths, temperature properties, and stress-rupture curves.

30 ELECTRONIC CONTROL SYSTEM —*Eaton Manufacturing Co, Dynamatic Division, Kenosha, Wis.* 8-page illustrated bulletin K-2 describes the K-2 Control developed for the recently introduced Ajusto-Spede drives Models ACM-903 and 904 which cover a range from 1 to 5 hp, as well as to units rated up to 30 hp. K-2 Control is designed to maintain set speeds within plus or minus 2% of the max speed of the drives at any point in the operating range.

31 NICKEL-CONTAINING CASTING ALLOYS—*International Nickel Co, 67 Wall St, New York 5, NY.* 27-page booklet presents condensed data on range of properties offered and general applica-

(Continued on p 205)



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cordially invites your visit for a demonstration — in actual operation — of some highly interesting machine-tools of own design and incorporating all latest improvements. — The exhibits include:

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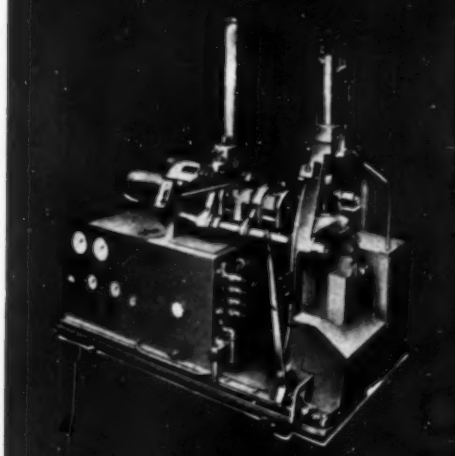
2 VARIOMATIC Indexing Table and Multi-Operation Machines,
one being equipped with work feeding magazine and the other for machining from coil. (3)

Pressure die-casting machines for non-ferrous metals, models HK 406 (4) and HK 100/16

2 Capstan Lathes Model RE 25,
one being tooled up for bar work and the other for chuck work. (5)

Circular indexing tables.



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PITTSBURGH PLATE GLASS COMPANY

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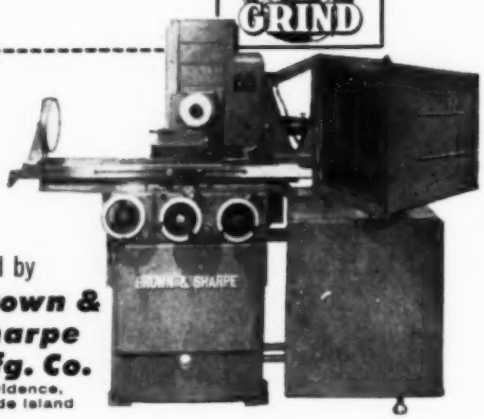

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NOW you can have a boring head that will **BORE, FACE, TURN** and **GROOVE** at no higher cost than you would pay for an ordinary, single purpose boring head

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tions for each of the alloys. Six-page fold-out table pinpoints important properties of each alloy and its uses in various fields; composition and properties covered in detail.

32 ELECTRO - MECHANICAL COMPONENTS—*Sterling Precision Corp, Instrument Division, 17 Matinecock Ave, Port Washington, LI, NY.* 512-page catalog 60 covers more than 20,000 electro-mechanical, development, electronic, gearing, and tool components available from stock. Engineering data and ordering information provided.

33 GEARMOTORS — *Allis-Chalmers Manufacturing Co, Milwaukee 1, Wis.* 8-page bulletin 51B9172 describes design and construction features of units available from ¼ to 100 hp. Integral and all-motor types are covered, including right angle as well as special designs.

34 PHOSPHOR BRONZE ROD — *Bridgeport Brass Co, 30 Grand St, Bridgeport 2, Conn.* Technical bulletin presents data on alloy of copper, lead, tin, and zinc that is particularly adapted to applications requiring corrosion resistance, strength, electrical conductivity, antifrictional properties, low-temp performance, or non-magnetic characteristics. Covers physical, mechanical, and fabricating properties and common fabrication processes.

35 SELF-THREADING NUTS—*Palnut Co, 81-L Glen Rd, Mountainside, NJ.* 8-page bulletin gives complete data on line of nuts which form their own threads while tightening on studs of any malleable materials including zinc and aluminum die-cast; also on rods, wire, and pins of steel, aluminum, brass, or plastic. Includes engineering and assembly data, torque-tensile factors, dimensions, applications.

36 PLATINUM-GROUP METALS — *Metals & Controls, 34 Forest St, Attleboro, Mass.* 8-page brochure describes products including solid and clad platinum metals and alloys in sheet, strip, wire, foil, and seamless tubing, parts, shapes, and specialties. Lists physical and chemical properties of platinum. Dimensions are given for platinum-group metal mill products, anodes, and gauze.

37 REDUCED-VOLTAGE STARTERS —*General Electric Co, Schenectady 5, NY.* 8-page bulletin GEA-6860 defines, tells when and where to use, and how to select reduced-voltage motor-starting equipment. Contains starter selection table and a comparison table for determining which unit best suits the desired application. List of modification kits available is included, plus listing of variety of enclosures.

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. . . because CDT specializes in designing and building tools and machines for today's high production demands.

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. . . because CDT tools, jigs, fixtures and machines are precision engineered and built to the strictest requirements.

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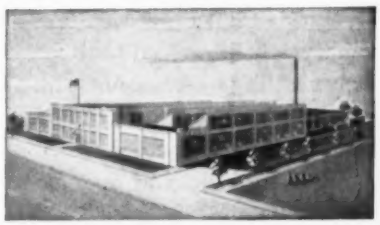

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THIS is full of ideas faster payback...

If ever there were a master mind in machine tools, it's Frauenthal's Single Spindle Vertical Precision Grinders!

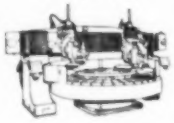
These heads are crammed with special talents . . . busy ideas that up production on *more* of today's jobs. And Frauenthal builds in flexibility that anticipates tomorrow's work assignments for sustained profit life. All a result of look-ahead engineering that gives you *widest* possible working ranges and more *application potential* than any comparable size machine.

More Frauenthal 1200 Series advantages: choice of either belt-driven or direct-connected grinding spindle types—uncanny accuracy — super-precision to .0001" at the spindle nose. Extra rigidity with all-welded steel base construction. Unique positioning versatility — for angular, internal, outside diameter and face grinding. Tracer control or numerical control available for contour grinding. Simplified design — with pushbutton controls for freedom in setup and operation. Write direct for 1200 Series Grinder details.

Above—Frauenthal direct-connected model (slide and spindle positioned for angle feed grinding). *At right*, Frauenthal belt-driven model. These grinders have an extreme angle setting of compound at 45° . . . spindle at 90° to slide. Machines with either spindle arrangements are offered with 24" dia. tables x 36" swing . . . 36" dia. tables x 48" swing . . . and 42" dia. tables x 54" swing.

F PRECISION PRODUCTION VERSATILITY

2200 Series 72-150" Swing

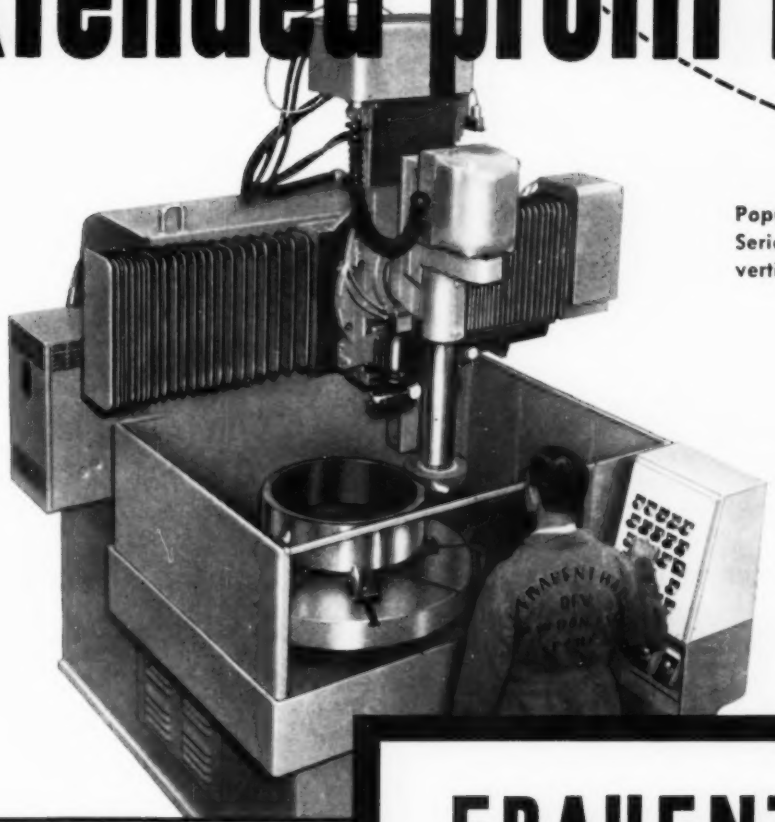


1800 Series 60-72-84" Swing

3100 Series 60-72-84" Swing

years to come . . .

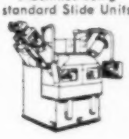
HEAD for extended profit life



Popular Frauenthal 1200 Series single-spindle vertical precision grinders

1200 Series 36-48" Swing

Special Grinding Machines using standard Slide Units



FRAUENTHAL

DIVISION

THE KAYDON ENGINEERING CORP.

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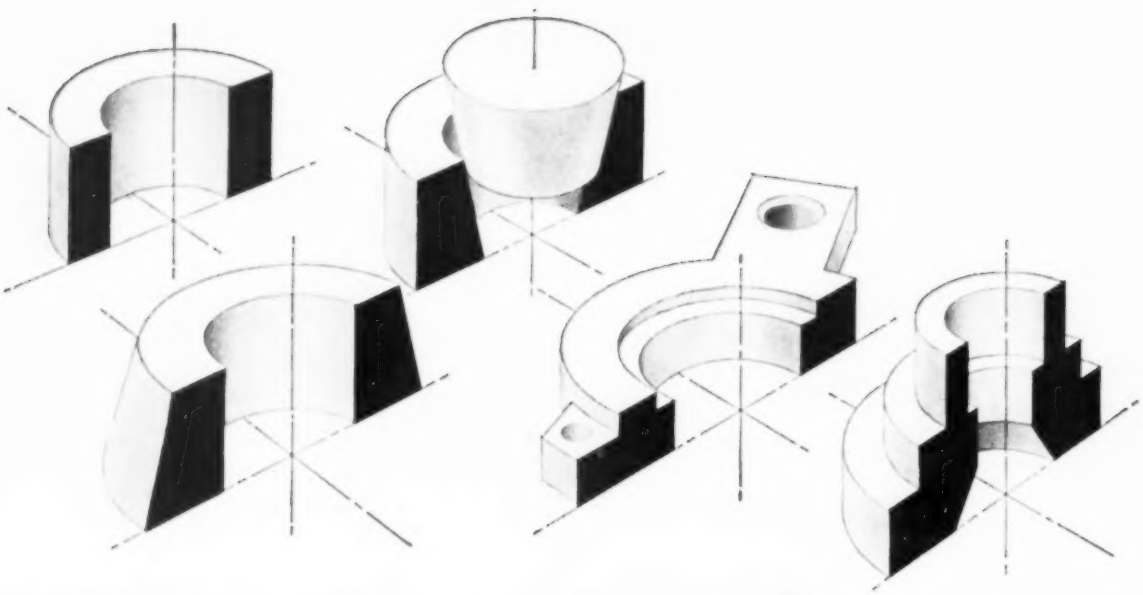

when to consider Vertical Grinding

A simple test you can try for yourself quickly determines whether you should consider the Springfield principle of *vertical* grinding. Try it!

CHECK YOUR ANSWERS TO THIS QUIZ	YES	NO
1. Do you grind holes 4" in diameter and larger?	☐	☐
2. Do you grind taper holes or mating parts?	☐	☐
3. Do you grind on irregular shaped work?	☐	☐
4. Do you grind O.D. or I.D. shoulders, offsets, undercuts?	☐	☐
5. Do you grind pieces requiring extreme concentricity?	☐	☐
6. Do you require a 5 micro-inch or better finish?	☐	☐
7. Do some of your grinding jobs require many setups?	☐	☐

If you answer yes to three or more questions, a Springfield vertical universal grinder probably can save real time and money in your plant. Mail the coupon today for your free and informative copy of "Vertical Universal Grinders"; Bulletin 197-F.

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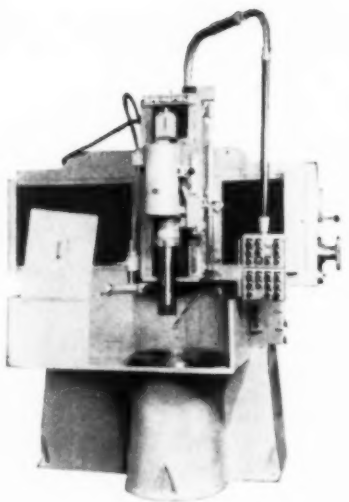

Above is a standard Springfield 2A-TR vertical universal grinder. It swings 25"; the grinding head has a 21" stroke and it grinds holes to a nominal depth of 18". The head can be tilted 45° in either direction. Electro-hydraulic control is standard with pendant pushbuttons. The Model 2A-TR costs less than most horizontal chucking grinders of comparable size; it can do the same work plus a wide variety of jobs that just can't be done on a horizontal. Gravity works for you in vertical grinding.

Loren K Hutchinson has been promoted to works manager of Wyman-Gordon Co's Worcester plant. He was previously manager of industrial relations

Paul G Mayer, assistant general sales manager of B-L-H Corp's Loewy-Hydropress Division, has been named general sales manager

William Roorda has been appointed director of production engineering at Clearing, Division of US Industries

NAMES IN THE NEWS...

Carra L Lane has been appointed manager of plant operations for the Chicago Pneumatic Tool Co, New York. He was formerly president and general manager of the Security Engineering Division of Dresser Industries.

James A Drain, who for the past 18 years has been a member of the management group of Joy Manufacturing Co, Pittsburgh, has joined the executive staff of H K Porter Co as a vice president.

James F Coleman has been appointed manager of the Instruments Division of W L Maxson Corp, New York. He was previously associated with Ford Instrument Co as manager of nuclear sales.

George W Brown has been elected president and chief executive officer of Wagner Electric Corp, St Louis, Mo. He succeeds the late **J H Devor.** Mr Brown, formerly executive vice president of the company, has also been elected president of its subsidiary, the Wagner Brake Co Ltd of Toronto, Canada.

Thomas P Sawyer has been named sales manager of Armstrong Bros Tool Co, Chicago. Formerly eastern district sales manager, he succeeds the late **Henry B Austin.**

John F Adamson has been promoted from assistant to chief engineer of American Motors Corp Wisconsin automotive operations. He succeeds **Floyd Kishline** who has retired.

John M MacCrum has been named vice president, sales, for American Forge & Manufacturing Co, McKees Rocks, Penna. He has been a member of the sales staff since 1952

Louis M Ballard has been named president of Micro-Path, Inc, a subsidiary of Topp Industries, Inc. He was formerly vice president and general manager of Vinnell Steel Co

Byron K Hartman has been named executive vice president and general manager of Syntron Co, Homer City, Penna, subsidiary of Link-Belt Co. Mr Hartman has been serving as sales manager of Link-Belt's Colmar plant outside of Philadelphia.

J G Rongitsch has been named assistant to the director of manufacturing of Hercules Motors Corp, Canton, Ohio. He was formerly assistant to the works manager of International Harvester Co's Louisville, Ky, plant. **Keith D Evans** has been appointed manager of quality control at Hercules Motors.

Norman I Botwinik has been elected president of Botwinik Brothers, Inc, New Haven, Conn, machine tool rebuilding concern, to succeed the late **Louis Botwinik.** He has also been named president of Botwinik Brothers of Massachusetts, Inc, an affiliated company in Worcester.

B G Tubbs has been named president of Vard, Inc, Pasadena, Calif, manufacturer of precision electro-mechanical devices, and a subsidiary of Royal Industries, Inc, Los Angeles. Mr Tubbs was formerly executive vice president and general manager of Royal Jet, Inc, another Royal subsidiary located in Alhambra.

L Eugene Root, vice president and general manager of Lockheed Aircraft's Missiles and Space Division headquartered in Sunnyvale, Calif, has been made group vice president, missiles and electronics. Company has formed separate missile-electronics and aircraft sections, each

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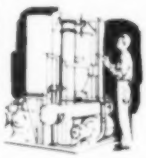
Hayes Sales Engineer
and General Sales Manager
personally invites you to

"SOLVE YOUR HEAT TREAT PROBLEM IN OUR LAB"

Ever since 1918, C. I. Hayes has maintained a laboratory of the latest *production-line* furnaces and allied equipment (not lab models) on which actual heat treating processes can be duplicated and evaluated. Here you can take an active part in developing the best heat treat procedure for your needs. You participate in developing equipment that's exactly right for your work.

CUSTOMERS ARE WELCOME to make use of the lab without cost or obligation. Hayes equipment *plus* our engineering know-how *plus* the Hayes library of case histories — this combination is ready to help you solve your problems . . . either with standard or special furnaces.



HAYES SHOWED THE WAY— others followed. There are several "Chinese copies" of the Hayes lab in industry today . . . proof positive that the right way to solve heat treat problems is the Hayes way — by experimentation and demonstration — not by "sweet talk".

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BULLETIN 1961 gives full lab details . . . write for your copy today.

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It pays to use HAYES for metallurgical equipment: lab, testing, furnaces, atmosphere generators, gas and fluid dryers.

NAMES IN THE NEWS...

headed by a group vice president. **A Carl Kotchian,** vice president and general manager of the Georgia Division in Marietta, has been named group vice president, aircraft. Both men will be headquartered at the corporate center in Burbank, Calif.

James P Falvey, board chairman of Electric Auto-Lite Co, manufacturer of automotive electrical equipment, has been named a Deputy Assistant Secretary of Defense, Supply and Logistics.

Carl Jakust has been named assistant chief engineer in charge of all passenger car body design at GMC's Chevrolet Motor Division. He replaces **Harold H Schroeder,** named director of car body research and development. **Harold O Flynn** has been appointed assistant chief engineer in charge of truck body design.

Heinz Hanau has been named director of engineering and research at Industrial Tectonics, Inc, Western Division, Compton, Calif. For the past nine years he has been associated with New Departure, Division of General Motors, most recently as supervisor of aircraft projects.

J A Rudy has been appointed industrial sales manager of Potter & Brumfield, the electromagnetic relay manufacturing division of American Machine & Foundry Co, Princeton, Ind. He was formerly a staff engineer with Automatic Electric Co, Northlake, Ill.

H W Gaeckle, general sales manager of the Dracco Division of Fuller Co, Cleveland, has been named vice president and general manager of Dracco, manufacturer of dust control equipment and pneumatic conveyors.

H B Hebble, who has been working on the development of vacuum induction melting of uranium for the past two and a half years at the National Lead Co of Ohio, in Cincinnati, has joined the Vacuum Metallurgical Department of F J Stokes Corp, Philadelphia, as product specialist on vacuum induction melting equipment.

W E Montgomery, chief sales service engineer at Firth Sterling Inc, Pittsburgh, has been promoted to chief engineer of the carbide division.

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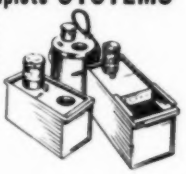

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As the basis for many of their hollowware items, Oneida chooses Bridgeport Fine Grain Brass and Copper strip. These metals are subjected to severe deep drawing and stamping. Rigid inspection assures that each piece of Community fully meets the company's unqualified demands for "perfectionism." The grain of the copper and brass strip must be closely controlled to take the many polishing and buffing operations that follow forming. At the same time, the strip must be sufficiently ductile to take deep drawing and stamping without cracking or waving. Strip surface must be absolutely free of any imperfections.

Fine grain brass and copper are only two of the many closely quality-controlled alloys produced by Bridgeport for the *benefit* of hundreds and hundreds of products. Strip, for example, can be made to the most exacting tolerances and finishes from end to end on Sendzimir mills. Your production operations benefit by running with fewer interruptions when you use Bridgeport's long-length coils.

Behind Bridgeport's outstanding products and manufacturing facilities is Bridgeport Technical Service, ready to help with your product design and production. Technical Service – plus top quality strip, tube, rod and wire are a combination that can make your product better, your production methods more efficient. Call your nearest Bridgeport Sales Office or write to Department 3010 for your copy of our "Fine Grain" Brochure.

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CATALOG NO. 258—Listing 343 Bunting Cast Bronze Electric Motor Bearings for all makes and sizes of electric motors from 1/50 to 100 HP.

BAR CARD 40—Listing 138 sizes of Bunting Bearing Aluminum Tubular and Solid Bars and giving comprehensive data.

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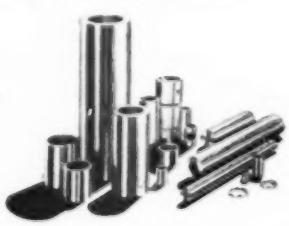


NAMES IN THE NEWS . . .

Ray T "Doc" Bayless, assistant secretary of the American Society for Metals, and associated with the Society for 37 years, has retired. Mr Bayless directed technical programming for the National Metal Exposition and Congress and also for the newer ASM Western Metal Exposition and Congress. He was nationally known in metalworking technology and metals literature publishing.

V M Holloway has been appointed general sales manager of Allis-Chalmers Construction Machinery Division. He was previously assistant sales manager of the division.

Ralph S Poister has joined Salem-Brosius, Inc, Pittsburgh, as vice president, research and development. He was formerly senior vice president of Crucible Steel Co of America.

Alfred Cutler has been appointed manager of international operations of H K Porter Co, New York. Mr Cutler has been serving for the past eight years as European manager of Hewitt-Robbins, Inc, Stamford, Conn.

Sam A Fittante has been promoted to superintendent of standards at the Chevrolet Gear & Axle plant in Detroit. He replaces **James E Tobias** who has been named general superintendent of production at the Flint plant.

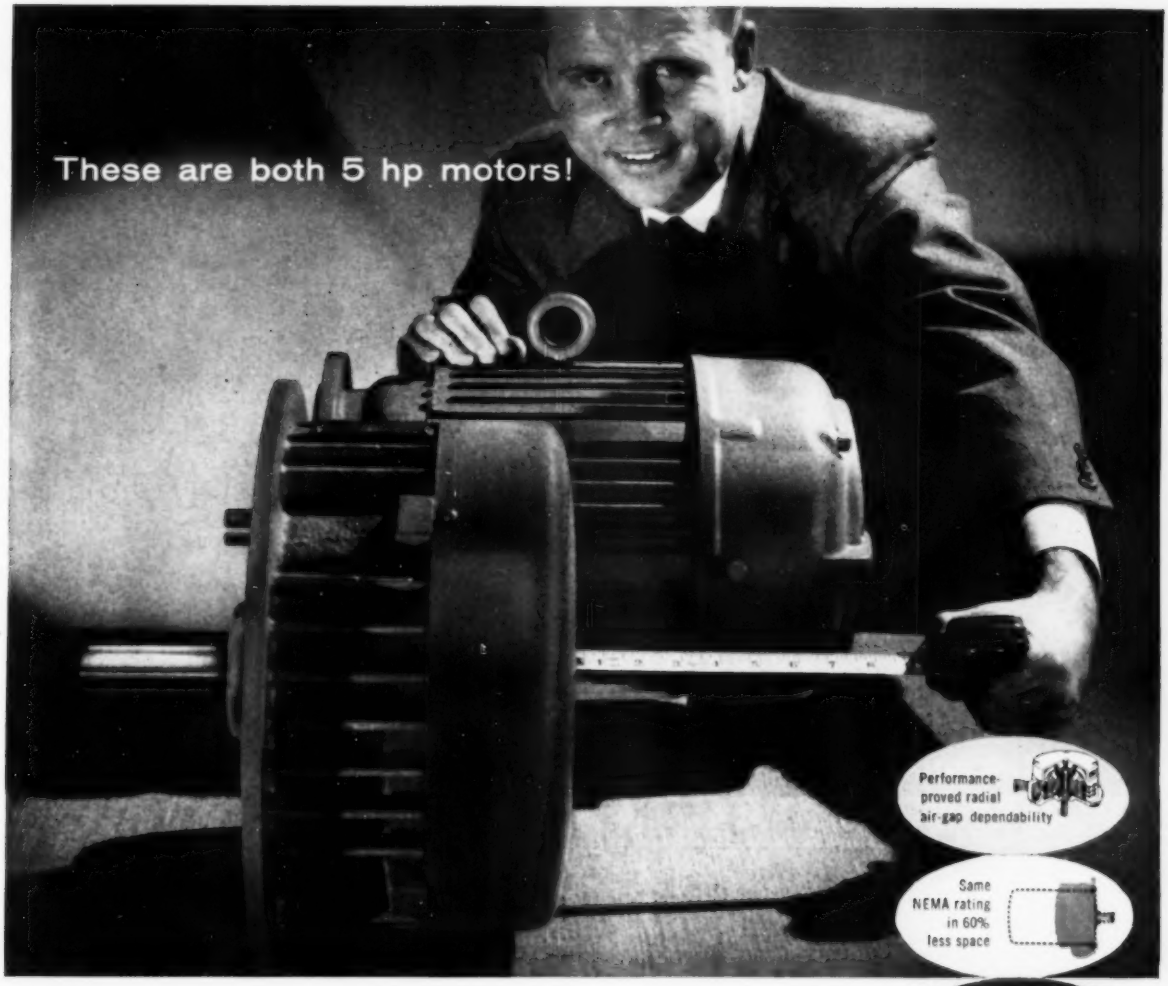
Hans Egli, engineering manager of Garrett Corp's AiResearch Industrial Division, has been appointed chief engineer.

W R Varney has been elected president and general manager of Angelus Steel Treating Corp, Los Angeles specialist in precision heat treating of aircraft, missile, and general industrial parts. Mr Varney was previously manager of the heat treating division of Calmec Manufacturing Corp, Los Angeles.

OBITUARIES

Albert F Wall, 68, board chairman of Wall Colmonoy Corp, Detroit, died Aug 3. He was also president of both Wall Colmonoy (Canada) Ltd, Quebec, and Wall Gases.

Alfred Kauffmann, 79, former president of Link-Belt Co, Chicago, and a director for 37 years, died Aug 7.



60% shorter– but with radial air-gap design!

New Louis Allis Pancake Motor preserves all the advantages of conventional motor construction

The new Louis Allis Pancake Motor is your solution to trouble-free power in any space-cramped motor application.

The Pancake is a remarkably short flange-mounted motor — up to 60% shorter and 33% lighter than standard motors of the same rating! And it is built in *conventional* radial air-gap design!

It's done by an ingenious forming process which literally compresses the end coils of a conventional radial air-gap motor into an exceptionally short length. The result is a compact, light motor ideally suited for horizontal or vertical mounting on machine tools, roof ventilating fans, or *any* close-quarter installation where space is a critical design factor.

What's more, this is achieved without sacrificing a single desirable characteristic: the stator still contains the same iron and copper as standard Louis Allis motors . . . standard NEMA service factor is maintained . . . high insulative values are retained by using proved Louis Allis varnishes and new insulating techniques . . . over-sized pre-lubricated bearings are used to guarantee long bearing life . . . and the entire motor is enclosed in an industrial-type cast-iron housing designed to shrug off abuse!

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The housing and flange are cast in one piece: this permits extra-accurate internal machining which extends bearing life and reduces noise levels to a new low.

Investigate the Pancake Motor through your local Louis Allis District Office. Sized from 1 to 15 hp, at 1800, 1200, and 900 rpm, in open drip-proof and enclosed non-ventilated or fan-cooled enclosures. Write for Bulletins 2100 and 2150 to the Louis Allis Co., 452 E. Stewart St., Milwaukee 1, Wis.

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MANUFACTURER OF ELECTRIC MOTORS AND ADJUSTABLE SPEED DRIVES

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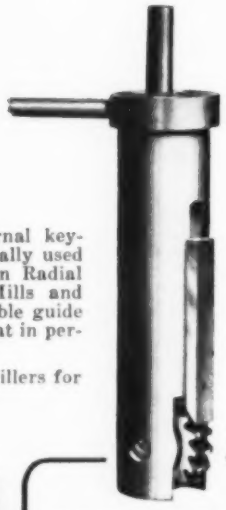

NATIONAL Keyseating Millers are mechanically simple in construction, sturdily built, designed for milling internal keyseats, faster and better. Although principally used in Drill Presses they can also be used in Radial Drilling Machines, Horizontal Boring Mills and Milling Machines. An exclusive demountable guide on body of Miller assures a straight keyseat in perfect alignment with axis of bore.

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NEW BOOKS...

SUCCESSFUL TECHNICAL WRITING—*By Tyler G Hicks. Published by McGraw-Hill Book Co, 330 W 42nd St, New York 36, N Y. 294 pages. Price $5.50.*

This remarkable book practices what it preaches. In clear, pithy style it presents an immense number of suggestions on how to write technical articles, papers, reports, instruction and training manuals, catalogs, advertising and books.

If this seems to cover more area than you care to tackle, you'll find it worthwhile for those sections dealing with phases that do appeal to you. The most universal interest is likely to be found in the first half of the book, which covers articles, papers, and reports.

In some candid advice on how to deal with editors, Mr Hicks shows an understanding of the breed that is almost uncanny.

Many approaches are possible in writing an article and some experts may quibble with the author's recommended methods. But certainly most will agree that he has a sensible approach for use by the engineer who is an amateur technical writer—and one that is used by many professionals, too. —*AA*

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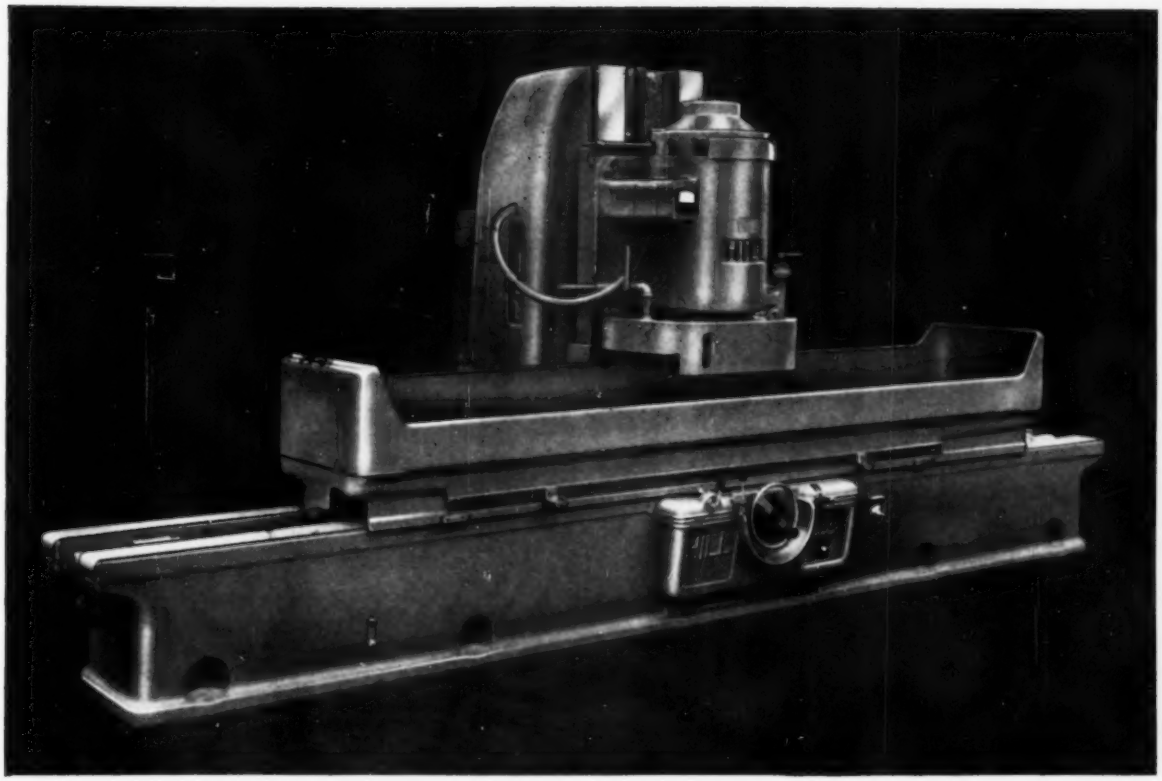
FILLER-METALS FOR JOINING—*By Orville T Barnett. Published by Reinhold Publishing Corp, 430 Park Ave, New York, NY, and distributed by American Welding Society, 33 West 39th St, New York, NY. 244 pages. Price $7.00*

Covering welding, brazing, and soldering, this book is a practical organization and explanation of the complex field of filler metals. It is intended for welding engineers, designers, welders and others who have to select a product from the great variety now being marketed.

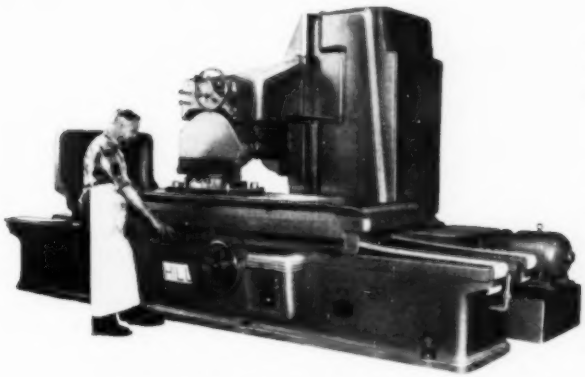
Brazing and soldering are each covered in one chapter. The major emphasis of the book is on manual welding, with separate chapters devoted to the numbered electrodes, E6010, E6011, E6012, E6013, and E6020-30, as well as chapters on low-hydrogen electrodes, iron-powder electrodes, and low-alloy high-strength electrodes.

Cast iron, stainless steel, aluminum, copper, and nickel have a chapter each, and individual attention is also given to tungsten electrodes, automatic welding, and surfacing.

The book may not give the final,



Hill Grinder ELIMINATES MILLING OPERATION



For grinding to extremely close tolerances on flats, angles, irregular and special shaped surfaces the HILL Horizontal Spindle grinder is recommended.

Expensive, time consuming milling operations can be eliminated in finishing die blocks, bolster plates etc. with the new HILL Vertical Spindle Hydraulic Surface Grinder. Equipped with either 75 or 100 HP main spindle motor, the segmented grinding wheel provides fast stock removal and produces an accurate finish in approximately half the time required for a combined milling and grinding operation.

The HILL fully hydraulic reciprocating table is adaptable to a wide variety of stock sizes having flat surfaces. Table widths are 18", 24" and 30" with table lengths from 5 to 20 feet.

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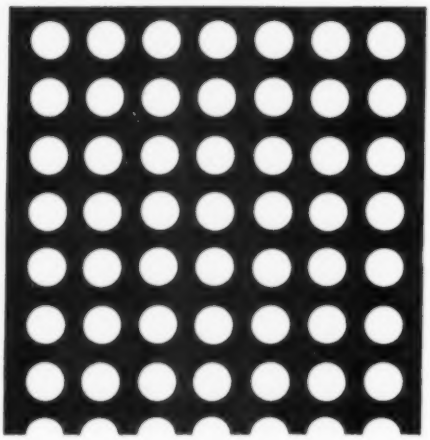

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specific answer to every joining problem, but it answers most of them. It also gives a good general background and explains why different filler metals have different characteristics.

A liberal use of case histories and examples helps outline common shop practices and filler-metal preferences. References are also given for the reader who needs more detailed information or specifications.

•

THE WORLD'S AUTOMOBILES – 1880-1958—*By G R Doyle. Published by Temple Press Ltd, Bowling Green Lane, London E C 1. 174 pages. Price 15 s.*

This is a third edition, evidently updated to include up to 1959, and covering all commercially manufactured automobiles of the whole world. No pictures, but it's *the* book for the car buffs. The main list—pages and pages of it—covers nationality, manufacturer's name and address, and years of production. There are also pages of interesting stories about historical cars and figures in the business—a fascinating little book.

•

REFERENCE INDEX OF THE CURRENT PROTECTIVE COATINGS SPECIFICATIONS. *Published by Office of Technical Services, US Dept of Commerce, Washington 25, DC. 159 pages. Price $3.00. Order as PB 151166.*

Federal, military, and contractor specifications for numerous protective coatings, including those for aircraft, paint, metal plating, ammunition, tubing, and wheel finishes are presented in index form. Included are new specification numbers listed with the superseded or comparable specifications. Requirements, guides, and classifications accompany the specs. Also included are charts of weights and measures, coefficients of thermal expansion, and metric equivalents.

•

BOLT, NUT AND RIVET STANDARDS — *Published by the Industrial Fasteners Institute, 1517 Terminal Tower, Cleveland 13, Ohio. 288 pages. Price $3.00.*

This third edition of these standards includes all of the current engineering standards, including those made since the 1952 edition. It brings to-

gether, in one volume, the nationally recognized dimensional standards for general-purpose industrial standards, and serves as a guide for both manufacturers and users of fasteners.

The standards, most of which were developed through the American Standards Association, were gathered and organized under the supervision of the Institute's Committee on Standards and Technical Practices. Complete standards are given for bolts, nuts, studs, screws, washers, and rivets. Other useful information includes grade markings, locknut specifications, terminology, Unified Screw Thread standards, and other data.

•

MACHINABILITY MANUAL — NO. 1: TURNING, FACING AND BORING OPERATIONS. *Published by John A Hedrick, Box 143, Parkerford, Pa. Looseleaf, 8½ x 11 in., including two circular slide rules. Price, $15.*

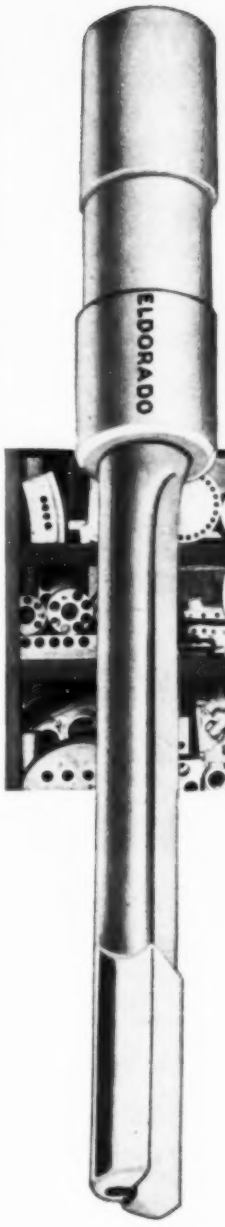
This manual provides a means of computing machining problems. Three basic units of information are provided: (1) tables of machinability ratings for steels and non-ferrous materials, (2) a machinability selector (circular slide rule) to provide speeds and feeds for any material with a machinability rating, and (3) a machining calculator (circular slide rule) that converts fpm to rpm, gives cutting time and number of pieces per hour, also gives horsepower for any depth of cut. Typical work sheets are included to record information in an orderly manner.

•

WHAT EVERY SUPERVISOR SHOULD KNOW—*By Lester R Bittel, Industrial Management Editor, Factory Magazine. Published by McGraw-Hill Book Co, Inc, 330 W 42nd St, New York 36, NY. 451 pages. Price $7.95.*

We are inclined to agree with the author that there is too much preaching, too little understanding, of the problems of first-line supervisors. Here the author has cast his entire book in the form of specific questions and answers—a sure antidote to glittering generalities. Two examples:

"When should you put an order in writing? Whenever you change an order that was previously in writing . . . or if the order must be carried over to another shift . . . don't depend too much on written orders. Not



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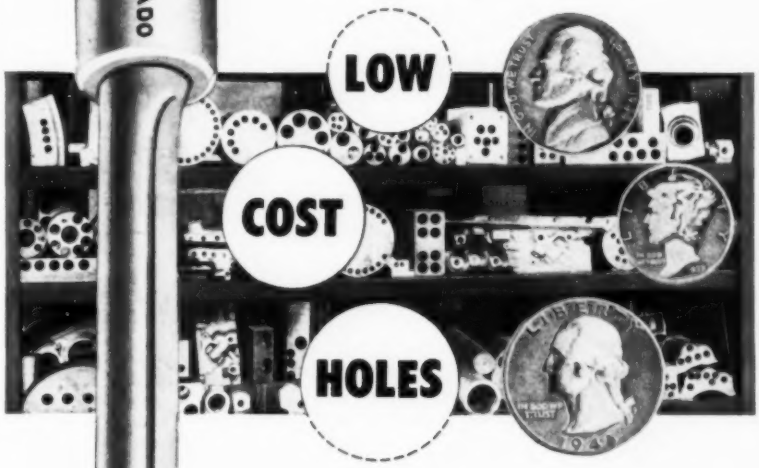

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OA Lengths	4" to 120" with dia. limits	10", 16", 22", 36"	16", 22", 36"
Drivers	Std. or to fit your need	.750" dia. x 2 3/4" long	1" dia. x 2 3/4" long
Tips	Carbide	Carbide	Carbide
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Added metal in Pannier fillet increases durability. Correct bevel gives clearer impression, longer life. Outside bevel longer than inside for protection of character face.

Made of the finest tool steel and correctly heat treated for best combination of hardness and toughness, Pannier single character stamps can take it! Scientific shaping and accurate engraving insure a long life of good, clear impressions. Available in letters, figures and special symbols, and in light, medium or heavy duty design.

Extra tough steel forging stamps for hot or cold, heavy duty marking

For stamping names, part or patent numbers, trade marks and similar markings, Pannier forging stamps are made in four styles:—Hand-style, fullered for wire handle and wood handle style with eye parallel or perpendicular to lettering. All are designed and heat treated for clear impressions and long service. All are covered by the Pannier Master Marker guarantee.

Supreme Holders with "Roto-Pin" for quick, easy number change

An easy, half-turn flip for Roto-Pin releases any or all of the steel type for fast change. A reverse flip locks them in perfect alignment.

Roto-Pin makes this Pannier Master Marker a time saver in number change and makes serial number marking fast and efficient. The hardened anvil at the base of the type slot keeps type in perfect alignment for equal impression. Machined from bar tool stock, the Supreme Holder has a heat treated striking head. Both anvil and striking head are replaceable for longer life of the holder itself. Made in hand or wood handle styles, for hot or cold marking.

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everyone follows written instructions easily."

"Why do employees resent discipline? . . . compare the civil procedure for handling lawbreakers with what happens in the plant. As foreman, you're often called upon not only to put the finger on the wrongdoer, but also to hear his case and decide how he should be penalized. To many an employee, this seems unfair because you've acted as policeman, judge, and jury."

This is a long book and it is packed with information, but it is organized so that it is easy to browse in it or to look up a particular subject. You are likely to find yourself looking up one answer, and staying to read many more. —*AA*

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A Diderot Pictorial Encyclopedia Of Trades and Industry—*Edited by Charles Coulston Gillispie. Published by Dover Publications, Inc, 180 Varick St, New York 14, NY. 2 volumes, 9 x 12 in. Price $10 per volume ($18.50 the set).*

Originally published two centuries ago, the French Encyclopedia was a monumental illustrated survey—the first of its kind—of the arts, the sciences, and industries as they existed before the Industrial Revolution. In its time, this 25-year project of French scholars led by Denis Diderot was revolutionary. It not only revealed trade secrets that had been zealously guarded for generations, but brought about great advances in industrial growth. Volume I, which appeared in 1751, can be considered the forerunner of the modern technical journal.

This new reprint—the first in 180 years—contains 485 of the 2900 copperplate engravings that accompanied the text in the original 34 vol-

"Looks like he got the raise. Before you ask him for an increase in your allowance, let me hit him up for some new clothes."

umes. Here are two sumptuous volumes that reproduce most of the original plates devoted to 18th Century trades and industry. Reproduction is excellent, and most plates are of the original size. A lengthy introduction orients the reader to the story behind the Encyclopedia publication.

Readers of AMERICAN MACHINIST will be especially interested in the section, toward the end of Volume I, that shows 18th century Metalworking. Forty-four pages reproduce pictures of eleven metalworking trades. Here are the shops of the toolmaker, the spurmaker, the cutler, the tinsmith, the swordmaker. Detailed illustrations of needle making, coin making, brass-pin drawing, and ironworking appear in this section. Many scenes are accompanied by separate, enlarged drawings of trade tools. The illustrations are in fact so complete that one could without too much trouble set up an 18th century shop of his own.

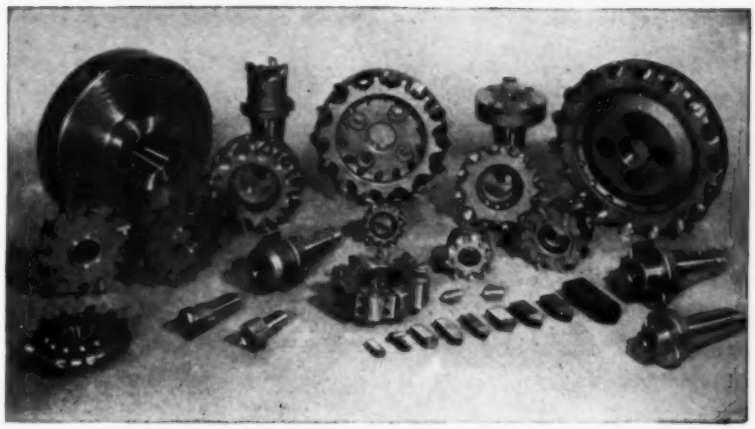
The Encyclopedia of course described all industries: mining, foundry work, glassmaking, textile weaving, and many more. All are represented here in abundant detail. And many metalworking industries appear outside the section devoted to Metalworking. Several pages devoted to the manufacture of metal buttons, for example, show work that is similar to that in many stamping shops today.

For the reader who wants to know what Metalworking (as well as other industries) was like 200 years ago, this two-volume set is by far the best currently available source. Today's plant manager harassed by lack of space, may well envy the simple, uncluttered "plants" of two centuries ago.

•

PEARLITIC MALLEABLE CASTINGS HANDBOOK. *Published by the Malleable Research and Development Foundation, Granville, Ohio. 74 pages, 5½ x 8½. Free to persons responsible for materials specification or selection.*

Pearlitic malleable iron is a relatively new material, which is finding increasing application in castings for critically loaded parts in machines and other products. This handbook was written to provide the latest technical information on the material. Chapters cover the structure of pearlitic malleable iron, facts on physical properties, and designing for various conditions. Economics of machining cast parts *vs* forged parts are included.



Milling Cutters — End Mills — Blades — Boring Tools — Arbors — Flywheels

These Lovejoy Products can help you Cut Costs!

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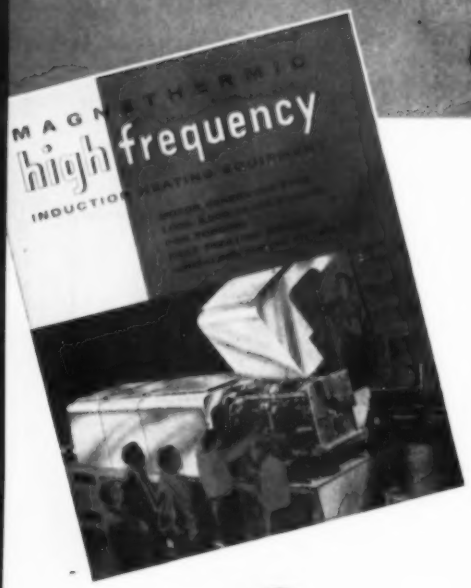
Springfield, Vermont, U.S.A.



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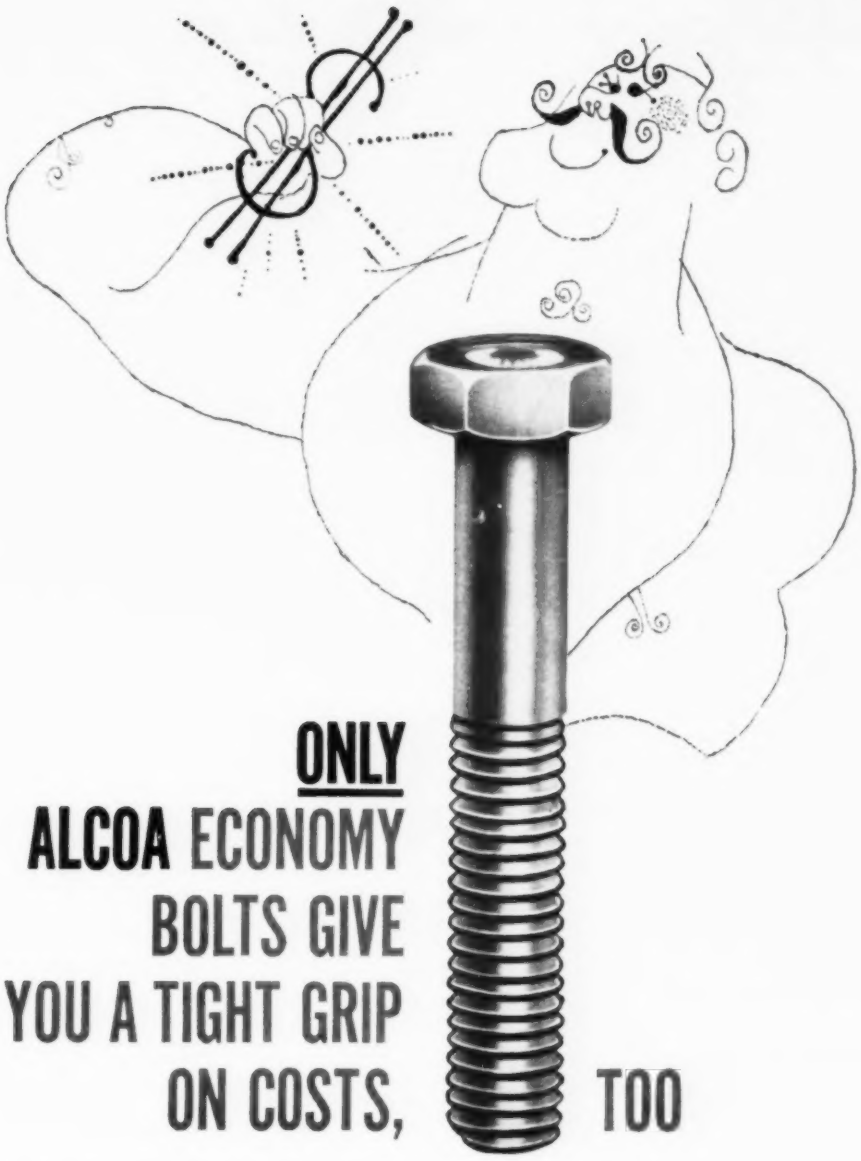

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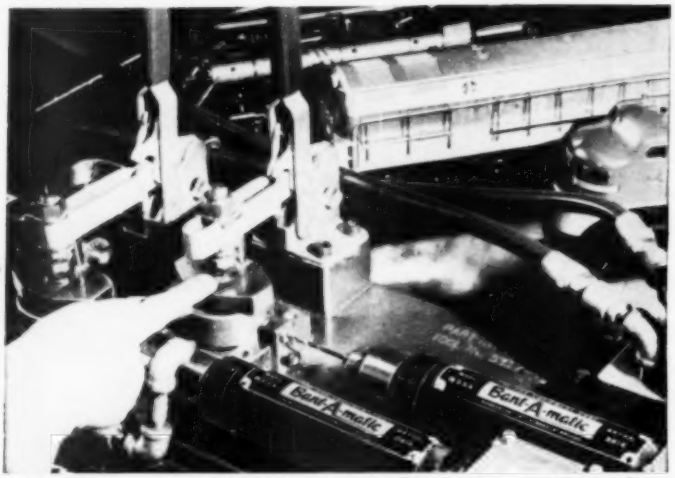
You do it!



YOU DO IT—using ARO components! That's the way the makers of Lionel trains automated drilling. They used ARO Bant-A-matics and accessories . . . installed by their own plant men.

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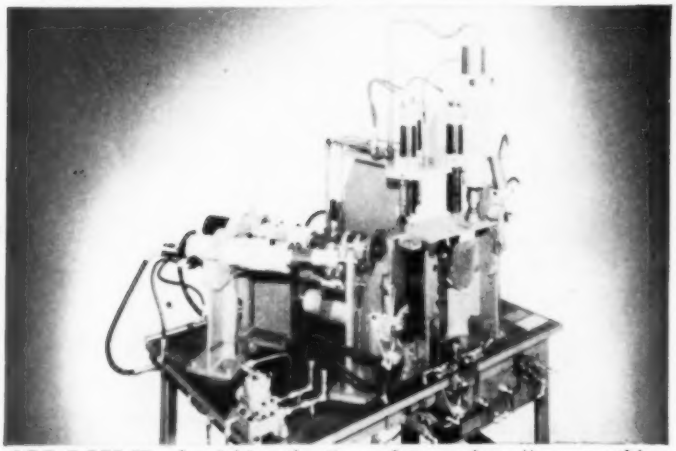
ARO does it!



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ARO

AUTOMATION AIR TOOLS

Name your problem in drilling, tapping or fastening . . . ARO can show you a simple way to solve it and step up production!

SINGLE OR MULTIPLE SET-UPS . . . air operated units for widest range of applications. Choice of 4 sizes. Capacities up to ¾". Minimum center to center distance 1".

ARO offers as much help as you need—from components to "complete package" including engineering, fixtures, accessories, automation tools and installation.

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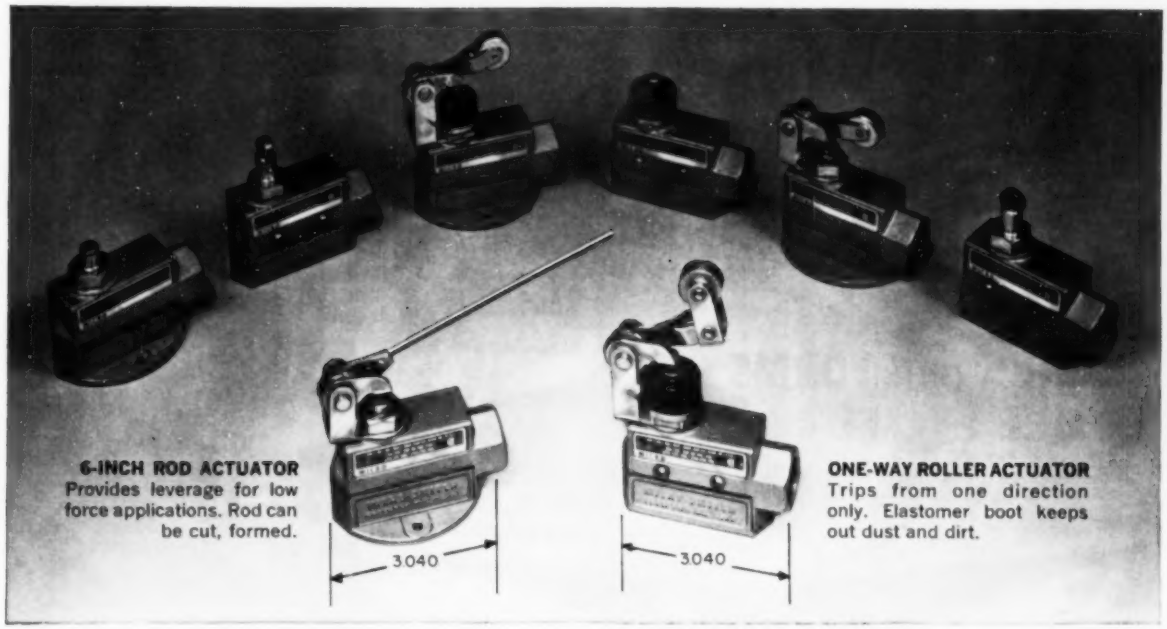
MICRO SWITCH Precision Switches


6-INCH ROD ACTUATOR
Provides leverage for low force applications. Rod can be cut, formed.
3040
3040
ONE-WAY ROLLER ACTUATOR
Trips from one direction only. Elastomer boot keeps out dust and dirt.

Two new actuator designs make "E6" and "V6" enclosed switch family even more versatile

MICRO SWITCH now offers *eight* actuator designs in its line of "E6" and "V6" enclosed, snap-action precision switches. The new one-way roller lever is ideal for machine tool applications that require a slide to actuate the switch, override it, and *not* actuate it on the return stroke. The new rod actuator is designed for low-force applications such as sorting and counting. The six-inch rod can be cut or formed to adapt to the user's specific requirements.

These remarkably compact switches are available for side mounting (E6), or bottom mounting (V6). They are easy to wire, well sealed, long lasting (through millions of operations), and will handle #0 and #00 contactors. Side mounting switches are available with #8 as well as #6 mounting screws. Send for Catalog 83.

CHARACTERISTICS		
	6-inch Rod	One Way Roller
Operating Force	2 to 5 oz.	8 to 20 oz.
Release Force	2 oz. min.	6 oz. min.
Pretravel	.718 in. max.	.234 in. max.
Differential Travel	.229 in. max.	.006 in. max.
Overtravel	.838 in. min.	.219 in. min.
Vertical Adjustment Field	1238 positions through 225°	990 positions through 180°
Horizontal Adjustment Field	8 positions through 360°	All positions through 360°

All "E6" and "V6" switches have a single-pole, double-throw contact arrangement. They are listed by Underwriters' Laboratories at 15-amps, 120-, 250-, or 480-vac; ½-amp, 125-vdc; ¼-amp, 250-vdc.

MICRO SWITCH . . . FREEPORT, ILLINOIS
A division of Honeywell
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Honeywell
MICRO SWITCH Precision Switches

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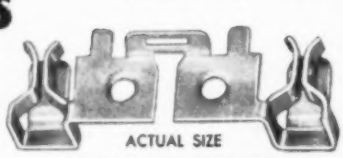
NILSON 4-SLIDE

BLANKS *and* FORMS IN ONE CYCLE!

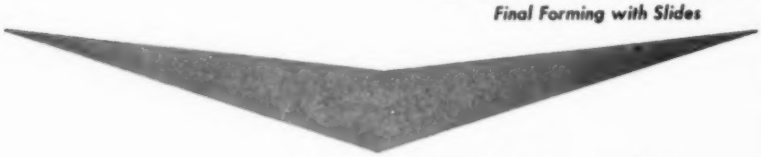
Cutoff

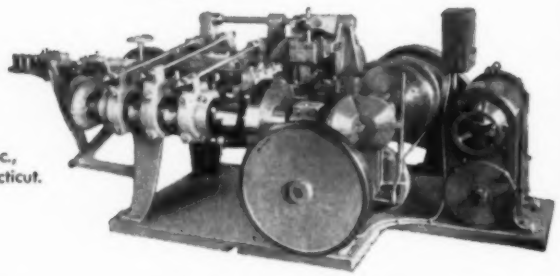
Partial Forming with Slides



ACTUAL SIZE

Final Forming with Slides





MANUFACTURER:
Harvey Hubbell, Inc.,
Bridgeport, Connecticut.

PRODUCT:
Contact Spring.

PRODUCTION:
136 Parts Per Minute.

Nilson 4-Slide Machine with Built-in Press

Harvey Hubbell shifted production of this part from a conventional press and progressive dies to a Nilson 4-Slide with built-in press. The immediate results: elimination of two secondary operations . . . simpler die . . . higher production rate . . . no stripping problems.

Harvey Hubbell also found that vertical mounting of die makes replacement easy . . . permits automatic disposal of scrap by gravity. And maintenance costs are incredibly low—this machine has been operating for twelve years without major repairs!

Nilson builds 7 models of ribbon metal forming machines, with built-in press sections ranging from 5 to 75 tons capacity. One of these machines may help you bring your stamping methods up-to-date!

Write today for the Nilson General Catalog on Automatic 4-Slide Equipment.

NILSON
THE A. H. NILSON MACHINE CO.
601 Bridgeport Avenue • Shelton, Conn.

AUTOMATIC WIRE & RIBBON METAL FORMING 4-SLIDE MACHINES • WIRE & STOCK REELS • WIRE STRAIGHTENING EQUIPMENT • AUTOMATIC STAPLE FORMING MACHINES • SPECIAL WIRE FORMING EQUIPMENT

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- **Maximum Diameter—5/8 inch.**
- For fast-production, multi-spindle machines.
- Specially heat-treated, high speed steel.
- With back taper or radial relief.
- Made by specialists in the design of small tools.

WOODRUFF & STOKES CO.
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PRODUCTION METHODS at GRAFLEX

Here are details of unique precision production methods at Graflex, Inc., Rochester. An *American Machinist* Special Report. 20 pages, illustrated, 25 cents a copy.

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BIG! RUGGED! VERSATILE!

Every inch a "Light-Heavyweight" . . .

New

WT ALKER-TURNER

20″ Variable Speed BAND SAW

With its massive construction and many other outstanding features, this new Walker-Turner 20″ Band Saw is a natural for heavy duty production work. Its variable speed drive permits dialing any speed from 50 to 4500 fpm—*while the machine is running*—for fast, efficient cutting of metals (even tough steel), wood, or plastics. Its big, heavily-ribbed tilting table rests on widely-spaced front and back trunnions and has an additional side brace. And, like the popular W-T 16″ Band Saw, this new "Light-Heavyweight" has safe, accurate guides that support the blade down to the work; solid bar upper guide post; and rugged ball bearing thrust support.

Your W-T dealer will be glad to give you details. He's listed under "Tools" in your classified telephone directory.

FREE CATALOG

Write to Walker-Turner Division, Rockwell Manufacturing Company, Dept. WJ-21, 400 N. Lexington Ave., Pittsburgh 8, Pa.

WALKER-TURNER
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another fine product by
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In this gleaming group are 2 steel herringbone gears of 28.24" O.D., 6" F., 9¾" B., 69 T., 2½ D.P.—another set of 28.24" O.D., 6" F., 10½" B., 69 T., 2½ D.P. All heat treated to 240-350 Brinell before machining. Pinions—14.4" O.D., 6" F., 7⅛" B., 36 T., 2½ D.P. Heat treated to 385-400 Brinell after completion. Stahl-built gears measure up—to the job, to specifications. Get our estimate.

SPURS TO 72" PD. 1 DP.
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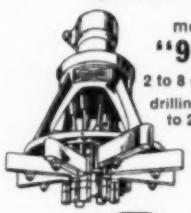
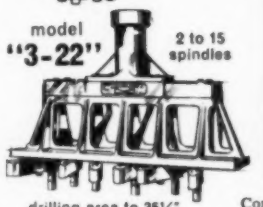
For LOW COST Hole Production
Pick a MULTI-DRILL® to Fit the Job



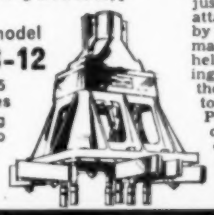
model "900"
2 to 8 spindles
drilling area to 22½"

model "500"
2 to 6 spindles
drilling area to 18⅛"



model "3-22"
2 to 15 spindles
drilling area to 35¼"

model "400"
2, 3 or 4 spindles
drilling area 3¼"



model "8-12"
2 to 15 spindles
drilling area to 25⅛" x 21¼"

Commander MULTI-DRILLS—adjustable multiple spindle drill press attachments—are sold and serviced by a nation-wide network of Commander Distributors—experienced, helpful specialists in solving drilling and tapping problems. Write for the name of your nearest Distributor and the complete Commander Production Tool Catalog which contains full details on every MULTI-DRILL and many other production drilling and tapping tools.

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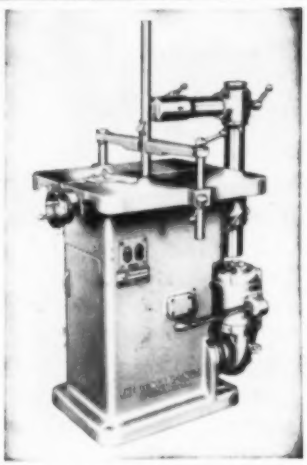
This new MORRISON KEYSEATER can make money for you



Install it in your shop. Its low cost will amaze you. Watch it pay for itself. You can quickly eliminate costly production tie-ups caused by waiting for expensive outside services. This is not an ordinary keyseater. The Morrison Keyseater is quality built with machine tool accuracy. Practically anyone can operate it. It has automatic feed, automatic stop to cut off feed at given depths, automatic relief to back the work away from cutters, automatic centering, automatic lubrication. NO BUSHINGS REQUIRED. Cuts keyways 1/16" to 1".

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Please send Free "Keyseater" Catalog, showing specifications.

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COMPANY_____
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If your metal sawing requirements are many and varied . . . if you have to cut the smallest, most delicate work or heavy solids up to 18"x18" . . . if you cut-off bar stock, pipe, tubing, moulding or structural shapes—then this MARVEL No. 8 Band Saw is the machine for you.

Not only is the MARVEL No. 8 Band Saw a truly universal machine capable of handling virtually any metal sawing job, but it does its work with unmatched efficiency, economy, and ease of operation. Many exclusive No. 8 Band Saw design and operating features such as vertical column design, control tower visibility, column and blade tilting to any angle up to 45° right or left of vertical for cutting at an angle or miter, are described in Bulletin 875. Write for it today. If you'd like a demonstration, mention the fact in your inquiry, and we'll arrange it at your convenience.

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Electronics is one of our fastest growing industries. By 1965 there will be thousands of new needs and new jobs.

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Nuclear energy is now supplying power for ships and electric plants. Future possibilities are virtually unlimited.

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Today there are more than 800,000 workers in chemicals and related industries. By 1970, there will be *twice* as many!

COMMUNICATIONS

As our nation grows, the demands made upon communications grow proportionately. Thousands more needs, more jobs.

EDUCATION

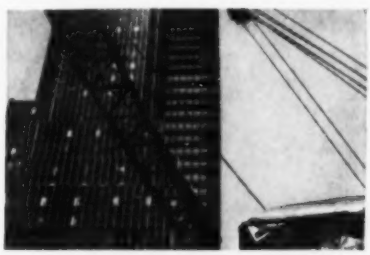
The giant school-building program now beginning will offer new jobs to many thousands of construction workers.

TRANSPORTATION

Our growing population demands constantly increasing mobility. Result: thousands of new opportunities, new jobs in the coming Jet Age.

FOODS

The trend is to labor-saving, ready-to-eat packaged foods. This new phase of an old industry will need thousands more workers.



CONSTRUCTION

3 million workers will benefit from new highway and construction programs—and even more workers will be needed soon.

7 BIG REASONS FOR CONFIDENCE IN AMERICA'S FUTURE

1. MORE PEOPLE—Four million babies yearly. U. S. population has *doubled* in last 50 years! And our prosperity curve has always followed our population curve.

2. MORE JOBS—Though employment in some areas has fallen off, there are *15 million* more jobs than in 1939—and there will be *22 million more* in 1975 than today.

3. MORE INCOME—Family income after taxes is at an all-time high of $5300—is expected to pass $7000 by 1975.

4. MORE PRODUCTION—U. S. production *doubles* every 20 years. We will require millions more people to make, sell and distribute our products.

5. MORE SAVINGS—Individual savings are at highest level ever—*$340 billion*—a record amount that is now available for spending.

6. MORE RESEARCH—*$10 billion* spent each year will pay off in more jobs, better living, whole new industries.

7. MORE NEEDS—In the next few years we will need more than *$500 billion* worth of schools, highways, homes, durable equipment. Meeting these needs will create new opportunities for everyone.

* * *

Add them up and you have the makings of another big upswing. Wise planners, builders and buyers will act *now* to get ready for it.

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Marketing includes sales, consumer research, product and package design, advertising and public relations. All need new skills every year—and *many thousands* of new workers!

FREE! Send for this new illustrated booklet, "Your Great Future in a Growing America." Drop a postcard to: ADVERTISING COUNCIL, Box 10, Midtown Station, New York 18, N.Y.

DI-ACRO NOTCHER Speeds Production, Saves Extra Operations on Chassis Work

"I use our Di-Acro Notcher for practically everything," says V. Johnson of Maico Co., Inc., Minneapolis manufacturer of hearing testing equipment. "This machine speeds production —*provides one operation notching* of cold rolled steel, brass, phosphorous bronze and aluminum up to 16 gauge thick. It's also used for notching fish paper, sponge rubber, 1/16" linen Bakelite and other circuit insulating materials that go into chassis for audio testing equipment."

The 4 ton pressure of this machine has the capacity to cut a 90° notch as large as 6"x6" in 16 gauge steel *in one operation*. Adjustable gauges mounted on work table are standard. Hardened and ground triangular ram assures years of precision. A clean cut, free from rough edges and burrs, is possible because blade clearance can be easily set. For high speed production, a power model is available.

Di-Acro Notcher is used on the open end of this .064" aluminum chassis at Maico Co., Inc.

Consult the Yellow Pages of your phone book under Machinery, Machine Tools for the name of your Di-Acro distributor or write us for Quick Facts Folder describing this and other Di-Acro machines.

Look in Your Yellow Pages

di-acro* PRECISION METALWORKING MACHINES

O'NEIL-IRWIN MFG. CO.

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*pronounced die-ack-ro

CIRCLE 326 READER SERVICE CARD

Skilled Hands Are Available in

In OLD Industrial Country

Bristol has had a depth of experienced industrial labor for 50 years and as our industrial community has grown, the size of this skilled labor force has expanded.

The working man in Bristol, Tenn.-Va., gets highest accolades from personnel departments of industries which have located here recently. Educational levels are unusually high and stability and dependability are far above state and national averages.

And Bristolians appreciate industry! Our industrial payrolls have been an integral part of our economy for many years and employee loyalty and capability have been our proudest asset.

There are hundreds of citizens of Bristol, Tenn.-Va., who'd like to be on your industrial team. We'd like you to come down and meet them.

Let Ford, Bacon & Davis Tell You The Whole Story

This nationally famous engineering firm has prepared an exhaustive analysis of Bristol's industrial potential. Write for your copy today—Dept. M959.

Bristol

INDUSTRIAL DEVELOPMENT BOARD

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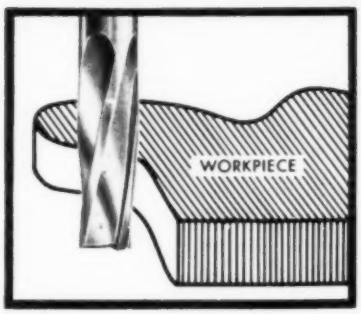
Atrax

Precision Ground
SOLID CARBIDE
TOOLS AND BURS

Job Applications

BETTER PROFILE MILLING ON 302 STAINLESS WITH 4-FLUTE, SLOW SPIRAL SOLID CARBIDE END MILL



After failure of H.S.S. End Mill, a Series 1505, 5/16" diameter "standard stock" Atrax Carbide End Mill was used. Operation performed on a Bridgeport with hand feed. Stock removal between .025"-.030" on roughing cut and between .005"-.006" on finish cut, both with same tool. Speed–2750 R.P.M.

SPECIFIC ADVANTAGES

of using this slow spiral, (approximately 15° right hand helix) Solid Carbide End Mill is the strengthened tooth form and reduced rake angle, not obtained with the regular fast spiral.

This Tool is designed and recommended especially for use on stainless steel and other

TOUGH TO MACHINE MATERIALS

stellite, titanium, nickel, chrome, monel metal and high temperature steels. Another decided advantage—this Atrax Tool can be run at slower speeds for longer tool life without injury to cutting edge.

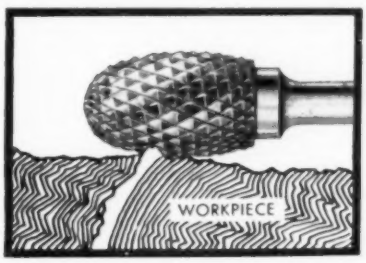
WHY USE A DIAMOND CUT BUR?

A diamond cut pattern which can be applied to a coarse, standard, or fine cut Bur is beneficial in the elimination of elongated slivers usually obtained when deburring such materials as stainless steel. In addition, the diamond cut provides greater operator control when used on hard materials, dies, molds, etc. and provides longer tool life on recommended applications.

NOTE: Speeds used with Diamond Cut Burs should be reduced by 1/3 to 1/2 the speeds of regular cut Burs.

HOW AN ATRAX E-161 BUR WITH DIAMOND CUT WAS USED

Hand operated at 8000 to 12000 R.P.M., using a portable air grinder, an Atrax Oval Type Bur was used to remove flashing from nodular iron castings.



Previously a H.S.S. Bur had been used with a tool life of 8 hours. The Atrax E-161 was removed for resharpening after 48 operating hours.

COSTS LESS 3 WAYS

Tool cost was $.06 per hour less with the Carbide Bur. The Carbide Bur also removed excess flashing from each casting faster with better surface finish and less operator fatigue. Atrax Oval Shape Burs are available from stock in Standard, Coarse, Fine and Chip Breaker types at no increase in cost.

WHAT IS A BUR WITH CHIP BREAKER CUT?

A chip breaker is a break in the continuity of the cutting edge which interrupts the cutting action, thereby breaking the chip into small sections and allowing improved tool control. Chip Breaker can be furnished on all Atrax Burs, on request, at no extra charge.

The job applications outlined here are taken from actual customer production experiences. We feel that this information can help you improve production, lower costs, and discover the superiority of Atrax Solid Carbide Tools and Burs.

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Grinder, C'less No. 2 Cincinnati, fimatic
Grinder, Disc: 22" No. 221 Hanchett opposed
Grinder, Int.: No. 171 Heald sizematic, 1952
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Lathe: 16" x 54" American Pacemaker, 1941
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Lathe: 25" x 72" Axelson, 1944 also 25" x 18"
Lathe: 60" Lodge & Shipley "T" 1954
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Lathe, turret: No. 4 J&L presel, 1942
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5. Bolt Machines
6. Boring Mills
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9. Centering Machines
10. Chucking Machines
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16. Drilling & Reaming Machines
23. Gear Cutting Machines
24. Grinding Machines
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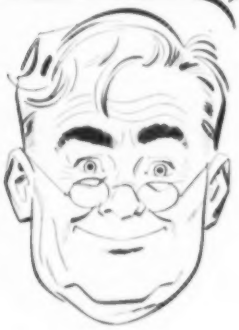

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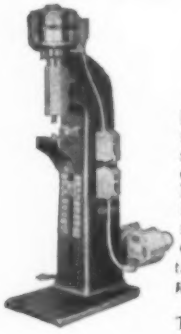

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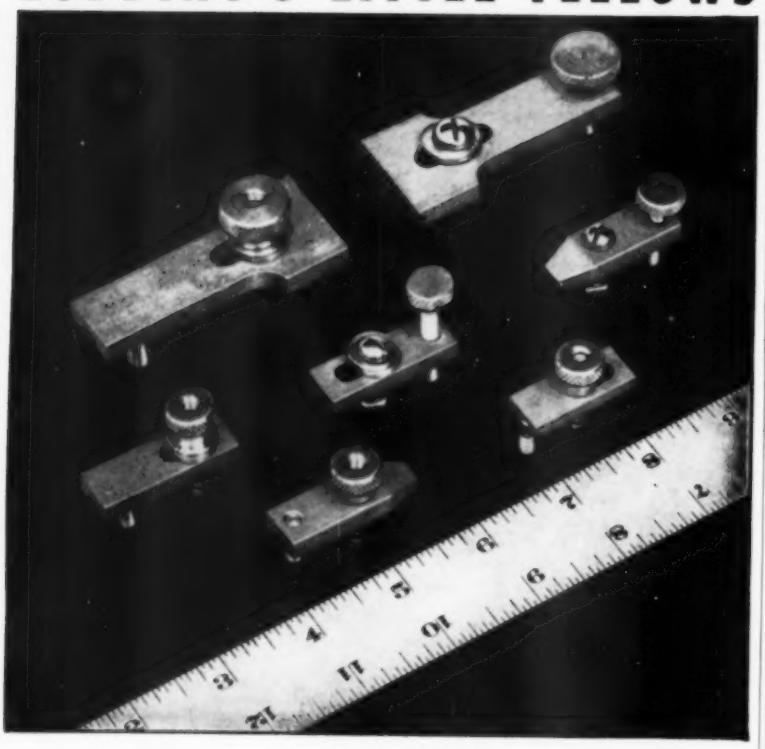

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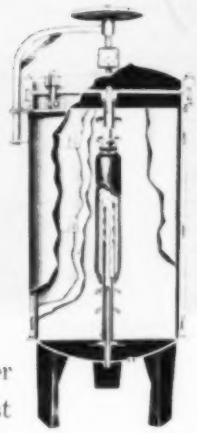

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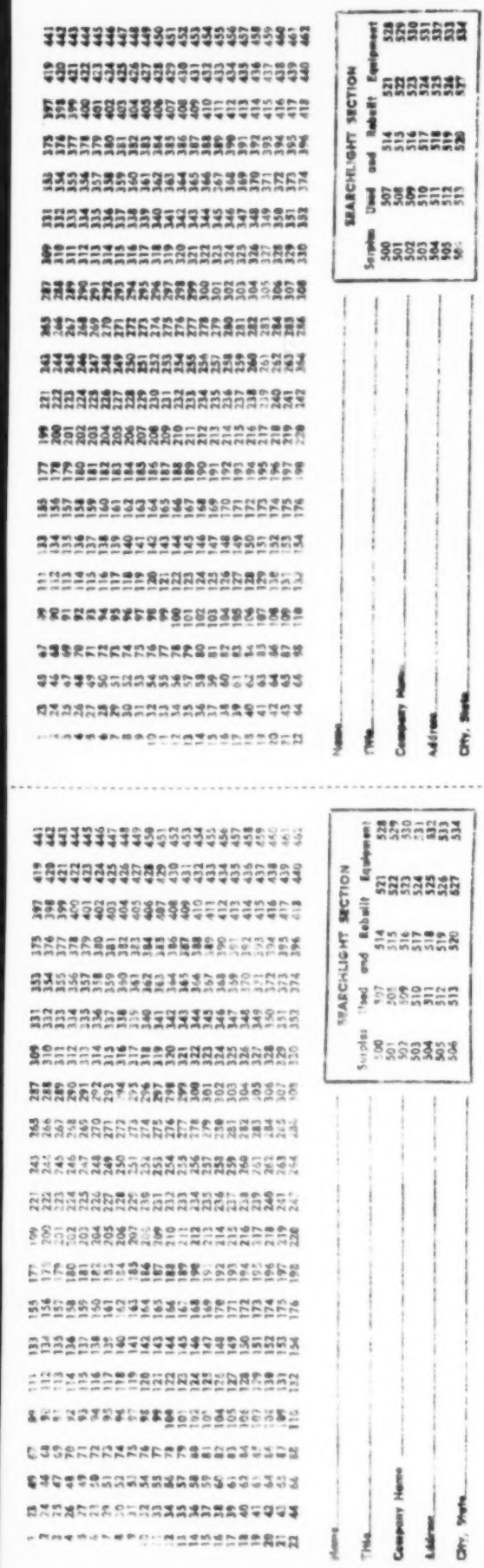

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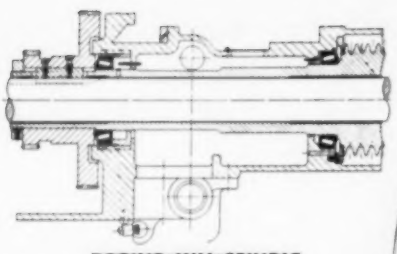

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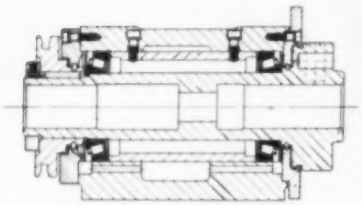

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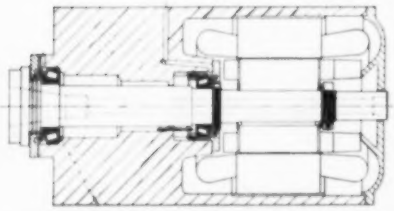

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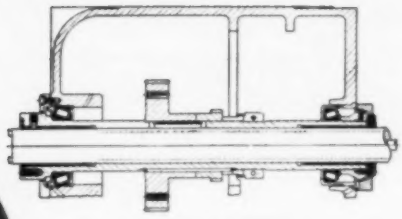

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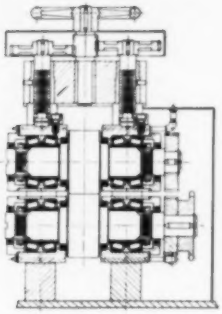

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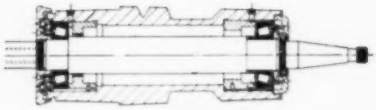

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